abk

SCHOOL OF EDUCATION
LIBRARY

JUL 8 1946

The Journal of Experimental Education

A periodical report of scientific investigations relating to child development, curriculum, learning, teaching, supervision, measurements, statistics, and experimental techniques.

Volume XIV | JUNE, 1946 | Number 4

CONTENTS

PAGE

A Study of the Educational Facilities in California For Children with Cerebral Palsy: *Lois R. Schulz* 267

Factors Affecting the Legibility of Handwriting: *Leslie Quant* 297

"What is Classification": *Arthur O. England and Harry Laurent, Jr.* 317

$5.00 A YEAR | PUBLISHED QUARTERLY | $1.50 A COPY

Published by Dembar Publications, Inc., 114 S. Carroll Street.
Madison 3, Wisconsin
Entered as second-class matter October 17, 1938 at the post office at Madison, Wisconsin, under the act of March 3, 1879.

EDITORIAL BOARD

A. S. Barr, Chairman, Professor of Education, University of Wisconsin, Madison 6, Wis.

Arthur T. Jersild, Professor of Education, Teachers College, Columbia University, New York City. Editorially responsible for materials on child welfare, guidance, and development, published each December.

Palmer O. Johnson, Professor of Education, University of Minnesota, Minneapolis, Minnesota. Editorially responsible for materials on measurements, statistics, and methods of experimental research, published each March.

H. H. Remmers, Professor of Educational Psychology, Director Division Educational Reference, Purdue University, Lafayette, Indiana. Editorially responsible for materials on learning, teaching and supervision, published each September.

J. Wayne Wrightstone, Assistant Director, Bureau of Reference, Research and Statistics, Board of Education of the City of New York, 110 Livingston Street, Brooklyn, New York. Editorially responsible for materials on curriculum construction, published each June.

CONTRIBUTING EDITORS

Emmett A. Betts, Research Professor and Director of Reading Clinic, Pennsylvania State College, State College, Pennsylvania.

Gilbert L. Betts, Supervisor of Graduate Research in Education, Colorado State College, Fort Collins, Colorado.

Leo J. Brueckner, Professor of Education, University of Minnesota, Minneapolis, Minnesota.

Oscar K. Buros, Associate Professor of Education, Rutgers University, New Brunswick, New Jersey.

Guy T. Buswell, Professor of Educational Psychology, University of Chicago, Chicago, Illinois.

Otis W. Caldwell, General Secretary, The American Association for the Advancement of Science, Boyce Thompson Institute for Plant Research, Yonkers, New York.

Leslie L. Chisholm, Associate Professor of Education, State College of Washington, Pullman, Washington.

Herbert S. Conrad, College Entrance Examination Board, Princeton, N. J.

Stephen M. Corey, Professor of Educational Psychology, University of Chicago, Chicago, Illinois.

Edward E. Cureton, Chief, Civilian Personnel Research Subsection, The Adjutant General's Office, War Department, 162 Larchmont Avenue, Larchmont, New York.

Robert A. Davis, Professor of Education, Director of Bureau of Educational Research, University of Colorado, Boulder, Colorado.

Harl R. Douglass, Director of College of Education, University of Colorado, Boulder, Colorado.

Jack W. Dunlap, Associate Professor of Educational Psychology, University of Rochester, Rochester, New York.

Harold A. Edgerton, Director, Occupational Opportunities Service, Ohio State University, Columbus, Ohio.

Col. John C. Flanagan, Chief, Psychological Branch, Office of Air Surgeon, Headquarters, Army Air Forces, Washington 25, D. C.

Carter V. Good, Professor of Education, Acting Dean, School of Education, University of Cincinnati, Cincinnati, Ohio.

Robert W. B. Jackson, Assistant Professor of Educational Research; Assistant Director, Department of Educational Research, Ontario College of Education, University of Toronto, Toronto, Canada.

Harold E. Jones, Professor of Psychology and Director, Institute of Child Welfare, University of California, Berkeley 4, California.

Noel Keys, Professor of Education and Lecturer in Human Relations, University of California, Berkeley, California.

D. Welty Lefever, Professor of Education, University of Southern California, Los Angeles, California.

Edward A. Lincoln, Consulting Psychologist, Halifax, Massachusetts.

Irving Lorge, Associate Professor of Education, Teachers College, Columbia University, New York City.

A. R. Mead, Director of Educational Research, University of Florida, 330 P. K. Yonge Building, Gainesville, Florida.

T. E. Newland, Lt. Comdr., USNR, 2702 Wisconsin Avenue, N. W., Washington 7, D. C.

C W. Odell, Associate Professor of Education, University of Illinois, Urbana, Illinois.

Willard C. Olson, Professor of Education, Director of Research in Child Development, University of Michigan, Ann Arbor, Michigan.

W. E. Peik, Dean and Professor of Education, University of Minnesota, Minneapolis, Minnesota.

S. L. Pressey, Professor of Educational Psychology, Ohio State University, Columbus, Ohio.

Clarence E. Ragsdale, Professor of Education, University of Wisconsin, Madison, Wisconsin.

William Reitz, Assistant Professor of Education, College of Education Examiner, Chief Statistician Air Cargo Research, Wayne University, Detroit 2, Michigan.

Henry D. Rinsland, Professor of Education and Director of Educational Research, The University of Oklahoma, Norman, Oklahoma.

Robert T. Rock, Jr., Professor of Psychology, Head of Dept. of Psychology, Graduate School, Fordham University, New York City.

Phillip J. Rulon, Professor of Education, Harvard University, Cambridge 38, Massachusetts.

Douglas E. Scates, Associate Professor of Education, Duke University, Durham, North Carolina.

David Segel, Educational Consultant, Specialist in Tests and Measurements, Federal Security Agency, U. S. Office of Education, Washington, D. C.

Paul W. Terry, Professor of Educational Psychology, University of Alabama. University, Alabama.

Helen Thompson, Clinic of Child Development, Research Associate, Yale University, New Haven, Connecticut.

Robert L. Thorndike, Associate Professor of Education, Teachers College, Columbia University, New York City.

Herbert A. Toops, Professor of Psychology, Ohio State University, Columbus, Ohio.

Maurice E. Troyer, Director, Bureau of School Services, Syracuse University, Syracuse 10, New York.

Helen M. Walker, Professor of Education, Teachers College, Columbia University, New York City.

Beth L. Wellman, Professor of Psychology, Child Welfare Research Station, State University of Iowa, Iowa City, Iowa.

Guy M. Wilson, Professor of Education, Emeritus, Boston University, Boston, Massachusetts.

Paul A. Witty, Professor of Education, Director of Psycho-Educational Clinic, School of Education, Northwestern University, Evanston, Illinois.

Ernest R. Wood, Professor of Education, New York University, New York City.

D. A. Worcester, Chairman Department of Educational Psychology and Measurement, University of Nebraska, Lincoln, Nebraska.

DEMOCRAT PRINTING COMPANY
MADISON, WISCONSIN

Journal of Experimental Education

Volume XIV | June, 1946 | Number 4

A STUDY OF THE EDUCATIONAL FACILITIES IN CALIFORNIA FOR CHILDREN WITH CEREBRAL PALSY*

Lois R. Schulz
University of Tennessee
Knoxville, Tennessee

INTRODUCTION

This study was initiated by the action of the Assembly of the California State Legislature in 1943. The State Department of Public Health and the State Department of Education were instructed to conduct jointly an investigation of the educational facilities for crippled children, including spastic children, in the State of California, and the "number of such in the State who are in need of and can be benefitted by special treatment or education". Though the Resolution as passed by the Legislature referred to crippled children and children with cerebral palsy, this survey was planned to include only children between the ages of three and sixteen who were handicapped by cerebral palsy.

METHOD OF INVESTIGATION

It was desired to obtain information from all public and private elementary and secondary schools within the State and from those state institutions caring for children within the age range of compulsory school attendance. Obviously, the extent of data thus to be obtained justified the use of the questionnaire method. The questionnaires were sent out from the State Department of Education.

Three forms of the questionnaire were constructed. The first form, Preliminary Inquiry, was sent to every district and to the director of every private and state school of elementary and secondary grades. A letter accompanied this blank explaining the purpose of the survey and the need for recognition of spastic children in the schools of California.

This preliminary inquiry blank served as a screening device for locating the children with severe cerebral palsy. Detailed questionnaires were then sent to all respondents who stated that spastic children were in the school or community. The information to be obtained by these questionnaires was of two kinds: the number of children with cerebral palsy who were attending schools in California; and, the educational programs for these children. One form, Questionnaire Regarding Children with Cerebral Palsy, was designed to obtain information regarding educational procedures in the schools and the other form, Report on Individual Children, to procure information regarding each child. It was hoped that this information would provide a state-wide picture of the educational facilities evaluated as to adequacy in meeting the needs of children between the ages of three and sixteen years who have cerebral palsy.

Personal visits were made to fifteen schools and information gained from observation and conversation with school personnel was incorporated into the data obtained from the written questionnaires.

I. Incidence of Cerebral Palsy in School Children

The problem of the spastic child has been complicated by lack of information regarding the numbers and location of these children. The data available have been collected by means of state registration, school attendance records, and house-to-house canvass in representative areas.

A. *Incidence based on state registration.*— Statistics show the incidence of cerebral palsy to be second in the diagnostic classification of all crippling conditions. The inadequate medical resources to treat cerebral palsy patients have discouraged parents from bringing their children to a clinic or hospital. The physical inadequacy of the individual with cerebral

* This study is a part of a doctoral dissertation done at the University of California and with the co-operation of the California State Department of Education.

palsy has made him socially unacceptable, and families have, therefore, endeavored to shield him from the unsympathetic attitude of people who misunderstand both the etiology of the lesion and the mental status of the individual. Educational facilities have been available, for the most part, only to those spastics whose degree of physical involvment is mild. Finally, there has not been state registration because the disease is not communicable.

The enactment of the Social Security Act in 1935 effected a marked increase in the state registration of all crippled children. The number of patients with cerebral palsy below twenty-one years of age on the registers of forty-five states shows an increase of more than 10,000 from the year 1939 to 1940.[1] The increase may be attributed to more adequate registration of old as well as new cases.

A wide range is found in the number of patients with cerebral palsy on the registers of the individual states. On the diagnostic classification for forty-five states in 1940, the state of Washington reported that only 2.0 per cent of all the cases of crippling conditions of patients under twenty-one years of age was due to cerebral palsy. This was the lowest percentage reported; Louisiana reported the highest, 18.1 per cent of all cases of crippling due to cerebral palsy. For the same year in California there were 657 children who were registered as having cerebral palsy. This was 5.7 per cent of all the crippled children under twenty-one years of age listed in the state file. This low figure is suggestive of an incomplete register rather than of a markedly low incidence of the disability.

Turner[2] suggests that the ratio of cerebral palsied children would normally vary from state to state because certain other disabling causes are epidemic and cerebral palsy is not. However, the disparity is such as to indicate that present registers are not an accurate index. States with the more complete registers show that cerebral palsy is not far behind poliomyelitis, for example, as a major cause of disability among children.

Duryea[3] has shown that there is no evidence that any geographical factor operates to influence the prevalence of cerebral palsy nor that there is any difference on an etiological basis between the incidence in rural and urban areas. From his study of 2,000 children who were under twenty years of age and not feebleminded, he concludes that "the incidence of cerebral palsy bears an apparent relationship to the birth rate although not necessarily a causal relationship and it is not subject to fluctuations". It may be expected that more optimum prenatal care which is possible in urban areas where more specialized medical facilities are available will operate to diminish the incidence, at least, in that selected group who realize the value of such early care.

B. *Incidence according to age groups.*— Analysis of the diagnostic groups of the state registers according to incidence in each age range shows comparable size groups for each period between the years five to nineteen with a slight increase in the ten to fourteen year group. Cerebral palsy is not always recognized in early infancy, and since nineteen is very near the age limit of the register, a decrease at both extremes is not surprising. From statistics published by the Children's Bureau, of the total 12,905 cerebral palsied children on the state registers, the following distribution according to age groups exists:[4]

Age Range	Number
Under 1	24
1–4	1,483
5–9	3,443
10–14	3,780
15–19	3,432
20	622

These figures suggest the size of the group of school age children that have cerebral palsy. It probably exceeds the size of the group which the school may anticipate, since cases with all degree and types of involvement are included. Significant for educational planning would be an incidence based on causative factors or type of involvement. McIntire's[5] study is suggestive. For one group of 146 children he reported the classification on the basis of etiology: birth injury, 63 per cent; intracranial defect, 19 per cent; encephalitis, 4 per cent. For 111 of the group there were 86 for whom the cerebral lesion was attributed to birth injury and 25 for whom it

[1] *The Child,* U. S. Children's Bureau, Social Statistics Supplement No. 4 (Washington: Government Printing Office, 1940).

[2] *The Farthest Corner* (Elyria, Ohio, National Society for Crippled Children, 1943), p. 6.

[3] Lyman C. Duryea, "The Cerebral Palsy Problem," *New York State Journal of Medicine* (September 15, 1941), p. 1819.

[4] *The Child,* Social Statistics Supplement No. 4 (Washington: Government Printing Office, 1940).

[5] J. Thomas McIntire, "Cerebral Palsy Treatment Experiment," *The Crippled Child* (December, 1942), pp. 48–49.

was attributed to a congenital defect. Fourteen of each group were reported to be mentally deficient. McIntire's conclusion, therefore, is that "congenital defects are the more serious etiological factor as mental defect is present in a much higher percentage of the congenital cases than in the birth injured ones."

C. Incidence based on school attendance record.—A study by McGann[6] in St. Louis checked school attendance records against the state register. This obviously can be done in large urban areas more accurately than in rural sections. For St. Louis the state register showed thirty-one cases of cerebral palsy whereas there were enrolled in the public schools of that city eighty-five spastic children.

The enrollment in special schools shows an appreciable number of children with cerebral palsy. In Spalding School[7] in Chicago, an elementary and secondary school with an enrollment of 900 in 1935, there were 450 children who were crippled from cerebral palsy. In 1943 the enrollment had increased to over 1,100, and of that number there were more children who were crippled from cerebral palsy than from any other single cause. Some increase may be due to the addition of a preschool unit for spastic children.

Figures for the Christopher School in Chicago, an elementary school only and with no preschool unit, show a similar picture. In relation to causes of crippling, cerebral palsy was responsible for a larger number than any other single cause.

D. Incidence on basis of house canvass.—To date the most successful type of survey from the standpoint of number of cases recorded is the police door-to-door census. Studies of this nature have been made in two eastern states, Maryland and New Jersey. Repeated samplings in these areas suggested a ratio between the number of patients with cerebral palsy and the general population. An estimation, therefore, of the number of cerebral palsy patients for the country may be obtained by applying to the total number of the general population, the ratio of the cerebral palsy cases to the population of the area studied. Turner[8] reports surveys made by Phelps on this basis which indicates that findings for both cities and rural areas are fairly similar. He states, "There is an annual increment of seven cerebral palsied children per 100,000 general population, . . . Of these seven, one dies before reaching the age of six, thus leaving six for every age group. In this way we can assume that there is a constant case load of ninety-six cerebral palsied children under the age of sixteen for every 100,000 of population".

E. Incidence in California.—Applying this ratio to California, the number of children with cerebral palsy in the state would be about 7,680 on the basis of a present 8 million population. McIntire[9] estimated a ratio of fifty-four educable cerebral palsy children under sixteen years of age per 100,000 general population, which for California would mean a school responsibility for 4,320 children with cerebral palsy.

Reports from the questionnaires of this survey do not locate this number of children. There are several reasons to account for this discrepancy:

1. Inflated state population.
2. Census limited to school records.
3. Compulsory school attendance beginning at age eight.
4. Children with mild degree of involvement adjusted to schools and not reported.
5. Severe cases not publicized.
6. Schools without medical service.
7. School personnel not qualified to diagnose.

It would seem reasonable to question whether the war emergency with the increase of defense workers and military personnel may not have altered the composition of the population in California from that of a prewar date. The difficulty which a family with a severely handicapped child encounters and which the child experiences moving from one locality to another often serves as a deterrent to such a move. California has no specific state-wide program for children with cerebral palsy which would influence families with this type of handicapped child to move to the state. There are exceptions. A few cases are

[6] Leona M. McGann, *A Survey of the Facilities for the Care of Cerebral Palsy Patients in the State of Missouri*, (unpublished M.S. thesis, St. Louis University, 1942).

[7] Edgar A. Doll, "Behavioral Consequences of Cerebral Birth Lesions," *Journal of Obstetrics and Gynaecology*, XXXI (May, 1936), 866–71.

[8] *The Farthest Corner* (Elyria, Ohio: National Society for Crippled Children, 1943), p. 7.

[9] *The Farthest Corner* (Elyria, Ohio, National Society for Crippled Children, 1943), p. 8.

known to have moved to California so that the child could attend a preschool for spastics, and medical facilities have drawn others to the hospital centers in San Francisco and Los Angeles.

Other reasons for the discrepancy between the census reported by this study and that quoted from Phelps, are inherent in the differences in the method of collecting the data for the two studies. Since the main source of information for the present study is the school record, the majority of spastic children reported would be those within the age range of compulsory education, eight to sixteen years. The house-to-house canvass referred to by Phelps included children from birth to twenty-one years.

Information in regard to some cases of spastic children was given to the school personnel by siblings, who were in school. Since many spastic children do not have siblings, as suggested by clinical studies,[10] it is likely that a number of such children would be omitted from a census depending upon data from school records. A typical case of this nature is that of X2, an only child of foreign-speaking parents who had been informed that nothing could be done for the child. The supervisor writes: , "We did not find the child until this spring. She has been seen by the doctor and he feels that her condition is favorable".

The school personnel are not qualified, nor expected to be, to diagnose conditions consequent to a cerebral lesion, and many schools are without medical services. Children with either severe or mild degree of involvement may escape the knowledge of the school personnel. Those with a mild degree have been able to adjust to the school routine with the result that they are not reported. Other severe cases are kept from public knowledge. That this latter fact is of significance may be judged by the number of cases reported without name or with notation that name and accompanying data be held confidential. There is need of social education for parents, relatives, and the community which will enable them to consider these spastic children with an objective attitude so that better care may be provided for them.

In compiling a census of children with cerebral palsy in California from the questionnaires returned by the schools, discrepancies were noted between the number of children reported on the preliminary form, approximately 1,200, and the number for whom individual reports were filed, 798. Several explanations for this difference are suggested. A few schools returned the first form and answered the question, "How many children are there in your district (or county) with cerebral palsy?" without searching for exact data. Therefore, when it became necessary to confirm the number with name and location of each child, the number decreased. There was duplication from some sections, which was discovered when the child's name was received, as for example, children whose homes were in the community but who were attending school in another district.

Another reason for a decrease in number was in the unwillingness of certain schools to give the child's name. Some reports were returned without name, but with other information so that they could be included in the study. Some schools, however, did not feel free to do this, and the number of detailed reports relative to children with cerebral palsy, based on the number of school reports, decreased in relation to the preliminary form.

There were 798 reports for individual children with cerebral palsy received from the following school groups:

Public Schools		556
Children in school	457	
Children not in school	99	
Private Schools		54
State Schools		2
State Institutions		186
		798

For the majority of the group it was possible to make an age-sex distribution. For the group reported by the school this is shown in Table I. Though the upper age limit of sixteen years was specified in the questionnaire, many of the pupils in the high schools were reported even though they had passed that age. In Table I they are classified as a group "over 16." The number in this group cannot be considered as exact since some respondents observed the age range specified and others reported the number in school regardless of age. The smaller number of children below the six-year level known to the schools reflects the lack of facilities available for children before the usual age for kindergarten or first

[10] Olga Bridgman, "Spastic Children in Outpatient Psychological Clinic," *American Journal of Disabled Children* (July, 1942), 11–18.

grade and is inherent in the method of data collection.

TABLE I

DISTRIBUTION OF CHILDREN WITH CEREBRAL PALSY ACCORDING TO AGE AND SEX

Age—Years	Girls	Boys	Total
Below 4	10	12	22
4– 5	10	10	20
5– 6	5	9	14
6– 7	17	20	37
7– 8	21	26	47
8– 9	13	26	39
9–10	22	26	48
10–11	17	26	43
11–12	12	28	40
12–13	11	27	38
13–14	17	24	41
14–15	19	20	39
15–16	14	20	34
16–21	47	42	89
Age not stated	2	3	5
Public School—Total	237	319	556
Private School—Total			54
State School—Total			2
State Institutions—Total			186
Total			798

The detailed data from 798 records form the basis for the further study of the educational facilities in California for children with cerebral palsy. A census of 798 spastic children under sixteen years of age cannot be considered the total number of spastic children in the state, but needs, rather, to be recognized with the limitations attendant a first school census obtained from records not primarily compiled for that purpose. The minimum of the size of the school problem, with regard to number, of spastic children may be considered, therefore, as one of providing for 500 pupils. The experience of the Crippled Children's Services in regard to other handicapped groups has been that when more adequate programs are provided, these "hidden children" quickly appear. It can safely be predicted that under an active statewide medical-educational program the known number of spastic children in California will increase rapidly.

II. ANALYSIS OF PROBLEMS INVOLVED IN THE EDUCATION OF CHILDREN WITH CEREBRAL PALSY

The emphasis of the present study was on the existing educational facilities available to those children with cerebral palsy who were enrolled in school or were appealing to the school for educational opportunity. In this respect, there were three areas in which the school was confronted with problems pertinent to providing school experience for spastic children: the presence of the child in the classroom; the provision of other types of instruction for the child who cannot attend class; and, the demands made upon the school by the home.

The etiology, treatment, and prognosis of cerebral palsy are complicated by the varied manifestations of the disorder. The range of the disability may be in relation to the degree of severity of involvement, which may be from a very slight degree to an incapacitating extent, or it may relate to the area of the body that is affected. The spastic child's behavior in the classroom may be considered to constitute a criterion of the adequacy of existing facilities, a basis for adjustments in the school regime, and a factor in determining school placement. From the 798 questionnaires regarding individual children, the problems indicated by the classroom teachers, the home instructors, and the administrators were related to acquisition of physical skills, evidences of mental capacity, and ability to participate in the academic program.

A. Physical deviations.—Muscular incoordination is recognized as one of the major difficulties of children with cerebral palsy. Schilder[11] has stated that "motor education of the child is the preliminary step in every education . . . Equilibrium is not merely a motor and vestibular but also a moral problem".

Basic to planning an educational program for the spastic child is a consideration of the degree of motor disorder for which modification of facilities are needed. Table II summarizes the data reported for 537 children relative to the areas of physical involvement which might be a factor in relation to the presence of the child in the classroom. For approximately 100 children there was no information regarding area or degree of involvement. For another 100 the responses suggested that the degree of disability was not prohibitive to the child's accommodation in established school facilities. The questionnaires did not designate any uniform, objective criteria on which respondents were to base their answers. It is recognized that persons who are familiar with the characteristics

[11] Paul Schilder, "The Psychological Implications of Motor Development in Children," *Processes of Fourth Institute for Child Research Clinic*, (Langborne, Pennsylvania: The Woods School, 1937), p. 59.

TABLE II

SUMMARY OF TYPES OF PHYSICAL INVOLVEMENT

Number of Cases Reported	Related Activity	Explanation
232	Locomotion	Involves legs, feet, back Includes scissors gait toe walking crawling assisted walking— crutches walkers use of wheel chair inability to sit or stand
192	Self-help	Involves arms, hands, back Includes difficulties in writing feeding self manipulation self-care
113	Speech	Involves lips, tongue, throat Includes non-understandable speech marked difficulty in speech complete lack of speech slurred speech stuttering—stammering uncontrolled volume uncontrolled pitch silent speech
21	Vision	Involves eyes, and position of head Includes difficulty in focusing— eye muscles head position surgery on eye muscles correction of refraction
4	Hearing	Involves ears Includes deaf defects in hearing range
104	Mild cases	Includes cases with mild degree of disability compensating ability adjustment to disability limited activity limited school participation

of cerebral palsy, or who are favorably inclined toward the spastic child, or who are sympathetic toward physical deviations might evaluate the areas of motor difficulty in a different way from the person otherwise biased toward the spastic child. Despite this difference in approach, the data have value in that there is evidenced the area of physical mal-functioning which makes the child a deviate in the school situation. For some children the disability was noted in one or more areas, such as a handicap in speech, locomotion, and self-help, whereas for others it was shown only by a disturbance in locomotion. Within each group wide variations in degree of impairment exist.

Locomotion.—More than 200 children were reported with marked difficulty in locomotion. Numerically, this is first in occurrence in all types of motor disorder. The significance of independent locomotion to school attendance is obvious. In general, the children who cannot walk are enrolled in special school, taught by a home teacher, or are lacking school opportunity. There are schools which cannot accommodate a wheel chair, and therefore a child who must use one cannot attend. There were reported in this study more than 100 children who are unable to walk or who are wheel chair cases in addition to many children who use crutches.

The abnormality of response of the leg muscles is conspicuous by the scissors gait or by toe walking. There was, for example, the eleven year old boy who "has a shuffling gait", the seven year old boy who now can "stand on toes when supported" or the five year old girl who "cannot walk because of a severe scissors gait but can be assisted on ski shoes".

Carlson[12] emphasizes the fact that the difficulty of maintaining balance makes falling an ever present danger. Examples of this were reported in various degrees of severity and indicated an influence upon the child's participation in school activities. There was reported one eight year old boy who "falls easily and has difficulty getting up" and another ten year old boy who "was unable to take more than two steps without support at eight years of age . . . had a skinned nose which never healed because he was always falling on his face".

Self-help.—From the standpoint of total motor function, the involvement of certain others areas may be more significant than that of walking. The hyperirritable or hypercontractile muscles of the spastic, or the excessive, unnecessary, and futile movements of the athetoid may be seen in the child's attempt to open his hand or to feed himself. Second in number of times reported were physical disturbances involving the arms,

[12] Earl Carlson, *Born That Way* (New York: John Day Co., 1941), 174 pp.

hands, or both. There was reported a ten year old girl who "eats fairly well alone and manages to partially dress herself", a thirteen year old girl whose "right hand is very helpless" and then a fourteen year old girl who "does walk but only short distances, is unable to use her hands but writes and feeds herself with her feet, has a good mind and reads on a level with children her own age".

Many examples exist of compensation for the lack of the use of one part of the body, particularly children who have one arm afflicted. A school nurse reported a six year old girl whose mother is greatly disturbed because the child uses her left hand in compensation for a handicapped right one. Lord[13] noted in relation to children's handwriting that many frequently compensated for their handicap by assuming bizarre positions. Such examples were frequent in reports to this survey.

Speech.—Various parts of the speech mechanism may be involved in cerebral palsy. Reverse breathing is characteristic of many spastic children and is probably an incoordination rather than a spasticity, since the diaphragm works in the opposite direction from the intercostal muscles. As a result only soft sounds can be made. One of the most handicapped children reported in this study was a six-year old boy who had what may be called "silent speech." Although he is able to direct his tongue muscles to the proper movements, it is only very occasionally and when he is completely relaxed that any sound can be heard.

Laryngeal difficulties commonly exist in which the individual is unable to control the volume of sound. In the case of athetosis, there may be lack of control of pitch. Embarrassment is inevitable for the individual who cannot be sure of the pitch or of the volume of his vocalizations. That this is a difficult problem in the classroom was reported from one school having a spastic boy graduating this year. He was not able to control the volume of his voice so that it might be kept at a normal pitch, and at times his voice was very loud. No speech correction was provided by the school, though the principal emphasized the need for such in the school program.

Speech is further disturbed by muscular difficulties. The posterior portion of the tongue may interfere with swallowing. The difficulty experienced by the spastic child in swallowing his saliva is a common and distressing symptom in this respect. The case is reported by a special school in a city school system of an eight year old girl who constitutes a true school room problem. The teacher writes this description, "X_3 is extremely difficult to understand. She drools on people and whatever she is near, paper, furniture, books. She always wears a bib all day because of excessive drooling".

In regard to tongue motions, Phelps[14] notes differences between the athetoid and the spastic. The athetoid demonstrates excessive motions of his tongue; the spastic shows lack of control. The athetotic individual has greater difficulty with the anterior portion of his tongue as shown by his limited ability in the pronunciation of sounds. Lack of control of lip motion may cause further embarrassment in speech or the difficulty may be in the throat muscles. M6 is a fifteen year old girl of whom the nurse wrote, "Her throat muscles are more affected than any other muscles. She speaks slowly and though not always distinctly, is easily understood". Example of another case was a ten year old boy who "has difficulty in speaking as his tongue and throat muscles are spastic".

Combined motor handicap.—Nor do these motor involvements affect children in only one part of the body. Phelps[15] comments on the significance of distribution as well as extent of the handicap. Many such examples were reported in this study: A fourteen year old boy, considered educable but has poor coordination, cannot write, has difficulty eating, shows handicap principally in speech and use of hands; or a twelve year old girl, considered educable but has slurred speech, falls some, and writes with difficulty.

B. Difficult areas in academic subjects.—The classroom teacher is confronted by the academic problems consequent to the physical handicap. They constitute a challenge to modification and adaptation of the educational techniques that will make learning possible. In answer to the question, "Do the children with cerebral palsy have any specific

[13] Elizabeth Evans Lord, *Children Handicapped by Cerebral Palsy;* with a medical explanation by Bronson Crothers (New York: The Commonwealth Fund, 1937), 100 pp.

[14] Winthrop M. Phelps, "Therapeutic Significance of the Mechanical Analysis of Motor Handicaps," *Proceedings of Fourth Institute for Child Research Clinic* (Langborne, Pennsylvania: The Woods School, 1937), pp. 5–9.

[15] Winthrop M. Phelps, "Management of Cerebral Palsy," *Journal of American Medical Association* (November, 1941), 1621–1625.

problems that you consider directly related to the handicap?" forty-five schools answered "Yes," twenty-five schools answered "No," and twenty schools left the question blank.

While pointing out that the spastic child has difficulties which the well child does not have, it is recognized that he shares with the well child many of the problems of learning, of difficulties in special subject matter fields, or of discipline. One teacher who had three spastic children in her class wrote, "They have the same problems of all adolescents." Seven regular schools considered that the academic problems of the child with cerebral palsy were the same as those of the other children in their groups. The spastic children enrolled in these schools manifested a mild degree of physical involvement. In contrast there were forty schools, including the special schools, which indicated that they considered the spastic child to have academic problems which the non-spastic child did not have. These responses suggest that the problems of the child with cerebral palsy bear a relationship to the handicap.

The following list gives, in order of frequency, the areas in which academic problems were recorded by the schools as typical of children with cerebral palsy. They reflect to an appreciable degree the physical disorders consequent to the cerebral lesion. The examples in each group are the teachers' comments.

SUMMARY OF AREAS OF ACADEMIC PROBLEMS

1. Speech
   Uses a sign language with various grunts.
   Makes series of different pitched tones.
   Good mind but unable to speak through lack of co-ordination.
   Inability to speak clearly or rapidly.
2. Writing
   Difficulty in writing legibly.
   Uses typewriter slowly and with errors.
   Very shaky and finds it difficult to write.
3. Motor Control
   Difficult in handling materials, tools, etc.
   Difficulty in activity games.
   Difficulty in seeing blackboard because of position of head.
   Difficulty in moving to classes.
   Difficulty in moving around easily; unable to do laboratory experiments.
4. Emotional Control
   Seems very emotional; a behavior problem probably due to vision.
   Highly nervous, hard to deal with.
   Had to be given a home teacher as he was too nervous to attend a regular class.
   Has given evidence of high temper but seems to have outgrown the outbursts.
5. Slowness
   Freezes if hurried.
   All movements slow.
   Needs to move at a slower pace than that afforded in regular class.
   Slow in oral expression, in writing.
6. Reading
   Eye co-ordination seems poor.
   Early training necessary.
   Has number sense but no reading sense.
   The teacher is working very hard with this eight year old girl trying to build up a readiness for reading.
7. Influence of group
   Spasticity increases when in a crowd, and learning becomes slower.
   Very restless in a crowd and demands much personal attention.
8. Arithmetic
   No apparent number concept.
9. Art
   No ability to draw.
   Can use only large motions.
10. Spatial Relations
    Hard to grasp.

There are references in the literature to similar problems. Lord[10] observed handwriting in relation to the motor handicap. She reported no consistent relationship between degree of motor co-ordination and skill in writing. There were difficulties in drawing which she did not consider were caused primarily by motor disturbances, but were rather in the nature of a "sensory defect that caused confusion in reproduction of direction". These children were able to draw from mental imagery, but could not imitate. There were examples of visual reversal of imagery and in a few rare cases an inability to attach meaning to pictured objects.

C. Evaluation of mental status.—A different type of problem but one upon which academic success is dependent is the deter-

[10] Elizabeth Evans Lord, *Children Handicapped by Cerebral Palsy;* with a medical explanation by Bronson Crothers (New York: The Commonwealth Fund, 1937), 100 pp.

mination of the educable potentialities of children with cerebral palsy. The relationship of a cerebral lesion to mental defect must be fully recognized and not be overshadowed with sympathy aroused by the physical symptoms. The etiological basis of cerebral palsy is in the cerebral lesion which may be of developmental, traumatic, or inflammatory origin. Exact responsibility for the lesion cannot always be correctly placed but may vary with individual cases.

Congenital defects as a cause of the cerebral lesion is recognized. There is little question that failure of the development of the cortical cells will cause mental deficiency. Conditions accompanying the birth process may contribute to lesions of traumatic or inflammatory origin. With regard to the prognosis of mental development in such patients, Tredgold[17] points out that "lesions of the brain, whether due to trauma or inflammation may exist without causing mental defect, or, indeed, any mental abnormality at all". He does add, however, that the phenomena of amentia, paralysis, or epilepsy may occur, singly or in combination as the result of such a lesion.

The literature further indicates that the prognosis for motor education is better for those cases in which the lesion is of traumatic origin than of inflammatory origin. For such cases the probability of acquiring motor skills as well as general learning ability, providing optimum conditions prevail, is greater than for patients in whom the lesion is of developmental or inflammatory origin. Thus on the basis of etiology of the lesion, mental deficiency must be recognized as an expected corollary to two types of lesion.

Crothers[18] gives three characteristics of the cerebral lesion which are significant in the educational picture. First, the lesion is fixed rather than progressive and, therefore, functional deviations will not necessarily increase. A second characteristic is that the lesion is diffuse rather than localized thus causing confusion in the response mechanism. And third, the injury has been imposed upon a growing organism whose patterns of behavior and motor skills have not been established.

The literature is convincing in regard to the complications which confront the individual who attempts to measure the mental status of the child with cerebral palsy. Because present instruments of measure emphasize verbal or motor responses, the evaluation of the intelligence of the spastic child is one of the major problems in the educational planning for him.

Studies of appropriate test items as a means of determining mental ability have been made. Cotton[19] enumerates the following characteristics as basic to tests for children with cerebral palsy:

1. There should be few verbal responses.
2. Fine muscle co-ordination should not be required.
3. The factor of time should not be important.
4. The degree of difficulty should challenge the subject.
5. Some indication of the subject's ability to apprehend a variety of relationships should be indicated.
6. Testing periods should be flexible in regard to time and number of tests.
7. The situations should be within possible experiential limits of spastic children.

Cotton devised four tests: sorting test for perception; light pattern for memory; string pattern for reasoning; and, completion tests for generalization and abstraction. When these tests were administered to a group of spastic children and a group of normal controls, there were certain differences noted in the responses of the two groups. The spastic group showed a wider range of individual differences in type of response within any one test situation, a greater tendency toward more concrete types of response with less ability to shift toward the abstract, and a tendency toward stereotyped responses regardless of the nature of the test situation. Children with the more severe speech handicap showed more stereotyped behavior and greater difficulty with abstract material.

From these findings Cotton suggests that "The injury which affects the speech area of the cortex may in turn affect the development of the association areas whereas injuries affecting motor abilities necessary for locomotion do not necessarily have this effect". She concluded that her findings indicate that there are situations which will provide valid

[17] A. F. Tredgold, *Mental Deficiency* (New York: William Wood & Company, 1937), 527 pp.

[18] Bronson Crothers, "Prognosis in Cerebral Palsy," *Journal of American Pediatrics Society* (October, 1932), 76–77.

[19] Blanche Carol Cotton, "A Study of the Reactions of Spastic Children to Certain Test Situations," *Journal of Genetic Psychology* (1941), pp. 26–44.

and reliable information regarding the mental ability and capacity of the spastic child.

Lord[20] planned "a testing program with the increase of abstractions as a guiding principle". Her selection of test items was from standard batteries and determined by the motor and speech facility of the child. She emphasized that in interpreting test results and comparing them with group norms, the spastic child's limited experience must be considered. From the results of her study, it seemed questionable if an objective evaluation of the mental capacity of the child with cerebral palsy could be obtained by means of an intelligence test alone. Lord, therefore, inquired for reports and demonstration of any changes in behavior that might indicate keener powers of observation or more complex integration of sensory cues as compared with previous tests. She also devised specific teaching tests to demonstrate the child's ability to learn.

On the basis of a combination of techniques to evaluate mental ability, Lord divided the group of spastic children at the Boston Children's Hospital into three classifications according to educability potentialities. In the first group were those children who showed a consistent mental development and demonstrated the capacity judged necessary for school work. An educational prognosis could be formulated for them. In the second group were those cases who showed what Crothers[21] called "arrested development", and defined as "an orderly and reasonably adequate development to a definite point". Lord observed that this arrest of development was apparent in her group in early childhood. This group could, therefore, be considered educable to only a very limited degree, and a static condition over a period of years was significant in the educational prognosis.

The third group included those who on the basis of test results showed marked irregularities in mental function. In regard to this last group, Lord suggests that "the mental status of the children is not inaccessible but it is inexplicable in the light of our present knowledge".

Information regarding the educability of the children in the schools reporting to this survey was given in various ways. Intelligence quotients were given for 113 children in the public schools. These were obtained from different tests: for forty-one children, from either form of the Binet; for thirty-nine children, from a combination of the Binet and some individual performance test; and for thirty-three, from either the Otis, Kuhlman, California Mental Maturity, or some other form of group test. The frequency and range of scores of these children are shown in Table III.

For a number of children to whom no mental test had been administered or for whom no report was available, the teachers' estimate of "educable" or "non-educable" or the quality of work or performance level was reported. "Educable" in reference to this group means the teacher's estimate of the ability of the child to improve in academic performance. For more than fifty children there is no record of estimation of educability because the respondent provided no information or because the respondent confused effort and ability. It is difficult to maintain an objective attitude toward a child who is seen daily and whose every action is an appeal for help. It is, therefore, not surprising that the teachers' sympathy and understanding of the child's need was sometimes predominant in the report.

Table III summarizes the evaluation of educability of some of the children reported to the present study. For the group it may be considered that the term "educability" refers to ability in academic subjects in comparison with the performance level of the usual school population. There is in this table the suggestion that the majority of the children known to the school personnel have educable potentialities. This is to be expected from the source of the data. Considering the seventy-six children who are reported to have intelligence quotients above seventy, the approximately 300 whose performance level of school work is of passing or better grade, and the twenty-three who are rated "educable" on the teachers' estimate, there are between 300 and 400 children of the 556 reported by the public schools who may be considered entitled to school opportunity.

That there are large numbers of non-educable children with cerebral palsy cannot

[20] Elizabeth Lord, "A Study of the Mental Development of Children with Lesion in the Central Nervous System," *Genetic Psychology Monographs*, VII (May, 1930), p. 454.

[21] Bronson Crothers and Elizabeth Lord, "The Conception of Arrest and Development," *Journal of American Neurological Association* (1934), 67–72.

TABLE III

EVALUATION OF EDUCABILITY

Score	Intelligence Quotient Test Used			Total
	Binet	Binet+ Performance	Group	
30– 40	0	2	0	2
40– 50	0	4	1	5
50– 60	2	6	3	11
60– 70	6	8	5	19
70– 80	7	3	6	16
80– 90	8	7	4	19
90–100	8	5	8	21
100–110	2	3	4	9
110–120	5	1	2	8
120–130	1	0	0	1
130–140	0	0	0	0
140–150	0	0	0	0
150–160	1	0	0	1
160–170	1	0	0	1
Total	41	39	33	113

Quality of Work Teachers' Estimate	
Reached limit	13
Not passing	33
Passing for ability	16
Poor	55
Average	30
Fair	103
Good	79
Good but retarded	21
Excellent	30
Total	380
Statement of Educability	
Educable	23
Non-educable	19
Questionable	20
Total	62

be ignored. Doll[22] reports that cerebral birth lesion is the cause of mental deficiency of ten per cent of the 450 enrolled at Vineland Training School. He states that "This condition seems, therefore, numerically second only to unfavorable heredity as a cause of mental deficiency".

McIntire[23] studied the incidence of feeble-mindedness in a group of 146 individuals, 100 boys and 46 girls, affected with cerebral palsy. The mental classification of this group showed an incidence of mental defectives of one in four thus giving an obvious positive skew as contrasted with the normal curve distribution of the general population. Another difference noted was that within the group labeled feeble-minded, mental defectives were distributed in terms of moron, imbecile or idiot in a much more even distribution than occurs in an unselected group of mental defectives.

Table III indicates that there are enrolled in the schools a number of spastic children for whom academic education is not possible. This group would, in all probability, be enlarged by a part of that ninety-nine who were reported to the survey but who are not in school and, therefore, had no academic rating reported. There were thirteen children who had "reached their limit" and sixteen who were considered doing "passing work for ability". These twenty-nine plus the thirty-seven for whom intelligence quotients below seventy were reported and the nineteen who were stated to be "non-educable" form a group whose academic limitations must be recognized as making school achievement impossible. For cases such as these, acquisition of skill in motor abilities may also be an impossibility because of mental deficiency.

In the group of 798 for whom individual reports were returned there were 186 children with cerebral palsy under sixteen years of age in two institutions caring for feeble-minded patients. Extremely limited physical abilities were characteristic of both groups, but the basis for commitment was the low grade mental status rather than the physical disability.

From one institution there were reported 350 patients with cerebral palsy, 126 of whom were below sixteen years of age. The distribution of intelligence quotients and chronological ages of this school age group is shown in Table IV. Obviously, some of the low extremes of these intelligence quotients were not determined by actual measurement, but, as stated by the psychologist, are an estimate, and in view of her long and comprehensive experience may be considered indicative of the potentiality of the individual. There is a relationship to be observed between the low mental ratings and the limited physical ability characteristic of the mental deficiency as well as of the physical involvement. Of the group of 126, locomotion was reported for nineteen males and fourteen females. This

[22] Edgar A. Doll, "Behavioral Consequences of Cerebral Birth Lesions," *Journal of Obstetrics and Gynaecology*, XXXI (May, 1936), pp. 866–871.

[23] J. McIntire, "Cerebral Palsy Treatment Experiment," *The Crippled Child*, XIX (December, 1942), p. 84.

TABLE IV

INTELLIGENCE SCORES OF INSTITUTIONALIZED PATIENTS

SCORE		AGE													
		3–4	4–5	5–6	6–7	7–8	8–9	9–10	10–11	11–12	12–13	13–14	14–15	15–16	Total
0– 10	M				1	1	1	3		1		2	2	1	
	F									1	3		2	2	20
10– 20	M	6	3	4	1		2		3	2		1	2		
	F	1	1	2	1		1	2	1			1	4		38
20– 30	M		2			3	2		3			2	1		
	F		1	4						1			1		20
30– 40	M	2		1								1	1	2	
	F		1	1					1	2					12
40– 50	M											1	1	2	
	F			1				1		1		1	1		9
50– 60	M				1		1		1		1			1	
	F					1				1				1	8
60– 70	M													1	
	F											1			2
70– 80	M							1			1		1		
	F														3
80– 90	M														
	F								1						1
90–100	M														
	F														
Total		9	8	13	4	5	7	7	10	9	5	10	16	10	113

was an inclusive figure for those who could walk with or without assistance and with facility or only to a very limited degree.

Table IV shows six of the group with intelligence quotients above sixty, but the complete census of 350 children and adults shows thirty-two above this point. Limited training of ten children was considered probable and a spastic class was organized for them.

From another institution, similar findings were reported: "Of sixty children sixteen years of age and younger, forty are idiots, fourteen are imbeciles, five are morons, and one is borderline. The idiots and lower imbeciles are not educable or trainable. We have 102 other patients with varying degrees of spasticity, most of them in the low levels of mentality, who are over sixteen years of age." The following comment was made regarding the physical ability of total group of 162 patients with cerebral palsy: ". . . approximately forty-one males can walk fairly well, and nineteen females walk fairly well. A few others can walk with assistance or can crawl about, but the balance are wheel chair and bed cases. Many are epileptic".

From the reports of both institutions, the question arises as to whether these low indices are not in certain cases, related to the physical inadequacy to demonstrate mental ability. Early physical training was not provided for many of these patients, and the physiotherapy now provided at the institution is too late to benefit most cases. Social consciousness has stimulated action to a greater degree in providing care for mentally deficient individuals and relief for their families than it has for patients suffering physical disabilities.

The relationship of cerebral palsy to mental deficiency is a significant one as regards number of children and educational limitations. In this latter respect, a less clearly defined problem exists. The academic progress of children with cerebral palsy is important in regard to final achievement. Lord's[24] research emphasized the three goals which may be anticipated in the education of the spastic child; one group whose educational potentialities justify school opportunity; another group whose limited mental capacity is reflected in a cessation of learning beyond a certain point usually reached in early childhood; and a third group who could not be expected to benefit by school opportunity because of mental deficiencies. Analysis of the cases reported to this study indicated that a similar classification may be expected of any group of spastic children. Educational plans need, therefore, to be made with the recognition that numbers of spastic children will show a very limited amount of improvement despite a very large amount of time, effort, and money expended for their care.

A few cases were reported which showed a negative change over a period of time in mental status as determined by mental tests. The number of such cases in this study was not large enough to draw any reliable conclusions, but there was in them a definite suggestion that the developmental pattern might be a retrogressive one, as suggested by Bridgman.[25] Bridgman reports a clinical study of 113 cases of presumably congenital spasticity. On the basis of repeated administrations of the Stanford Binet Mental Test she comments that the "results of tests at all ages are doubtful as to their diagnostic value in determining actual intelligence . . . on repeated tests there was as a rule a definite decrease in the intelligence level as the child grows older, in spite of the careful education which some of them have received". Of the small group, thirteen cases, which demonstrated educable potentialities, the majority were in the lower age group, and Bridgman concludes that "it seemed highly probable that some of them would fail to maintain this level".

D. School placement.—The age-grade placement of the 457 children reported enrolled in the five types of instructional programs is shown in Table V. Marked overageness is characteristic of the group. Only four children were under age for grade placement, one year for each child. The group at age for grade varied from one-third to one-fifth of the total number for every grade, except for the sixth grade in which only one child out of the twenty-three was in the grade for his age. Retarded age of admission and school transfers may be noted as contributory factors for the retardation of some children. R2 is one such example: He has been enrolled in a regular school, then in two special schools, then a year with a home teacher, and at present is back in a regular school.

[24] Elizabeth Lord, "A Study of the Mental Development of Children with Lesion in the Central Nervous System," *Genetic Psychology Monographs*, VII (May, 1930), pp. 365–485.

[25] Olga Bridgman, "Spastic Children in Outpatient Psychological Clinic," *American Journal of Disabled Children* (July, 1942), p. 12.

TABLE V

AGE/GRADE PLACEMENT

Age	GRADES pre-school	kdg.	1	2	3	4	5	6	7	8	9–10	11–12	Not in School Not Stated	Ungraded	Total
To 4	3												19		22
4– 5	11												9		20
5– 6	3	3	1										7		14
6– 7	3	2	23										8	1	37
7– 8			21	11	1								10	4	47
8– 9			10	9	11	1							5	3	39
9–10			7	7	12	10							5	7	48
10–11			3	5	7	7	8						3	10	43
11–12			3	1	6	15	5	1					3	6	40
12–13				1	1	9	8	7	6				0	6	38
13–14				1	3	4	4	7	5	2	1		5	9	41
14–15					2		3	6	3	12	3		5	5	39
15–16					2	1	3	1	5	5	3		3	9	34
16–17								1		3	6	1	5	9	25
17–18										1	9	8	6	3	27
18–19											3	8	2	2	15
19–20												5	1	2	8
20–21						1					3	6	1	3	14
Not stated			1		1								2	1	5
Total	20	5	69	35	46	48	31	23	19	23	30	28	99	80	556

E. Social behavior.—Doll[26] considers that disturbances of personality may very likely be a consequence of birth injury. The question was asked on the school questionnaire, "How do you consider these children with cerebral palsy when compared with other children in regard to behavior problems?" From the regular schools, thirty-seven respondents considered that the spastic and the non-spastic child in their respective schools demonstrated approximately the same kind and number of behavior problems; thirteen considered the spastic children to have more; twelve considered that they showed fewer problems; and eighteen left the question unanswered.

Some schools with more than one handicapped child in attendance responded variously for each one. Obviously a spastic child cannot be considered without regard for individual differences any more than a non-spastic child. The suggestion from the repetition in the schools' reports was, however, that the child's actions were the outcome of his frustrations resulting from his physical inadequacy. The nature of the behavior problems as reported in these questionnaires, show certain trends and may be grouped into approximately four categories:

Social Maladjustment:

Sensitive in social relations and cries easily if does not have own way.

One does not wish to follow our routine.

Much older and larger than classmates, therefore, self-conscious and children often make fun of his handicap.

Lack of Self-control:

Loses temper when thwarted.

Lack of self-control and nervous.

Easily excited.

Playing for Attention:

Accustomed to more attention than other children.

One is very well adjusted; other one is always demanding attention.

Wants recognition from group, easily influenced in behavior by others of his group.

Emotional Disturbance—Nervous Reactions:

Becomes tired, restless and moves noisily.

[26] Edgar A. Doll, "Behavioral Consequences of Cerebral Birth Lesions," *Journal of Obstetrics and Gynaecology*, XXXI (May, 1936), pp. 866–871.

These four types of behavior problems may be noted in other children as well as in this group of spastic children. The suggestion from the repetition in the schools' reports was, however, that the child's actions were the outcome of his frustrations resulting from his physical inadequacy.

There were numerous examples reported of behavior difficulties exhibited in the classroom situations. These, too, serve to emphasize not only the points of difference, but also the similarity between the social problems of the spastic and of the non-spastic child.

Social behavior is dependent upon opportunity for expression. Of primary importance to social learnings are motor development and language acquisition, the two greatest difficulties of the child with cerebral palsy. For an appreciable number of the spastic children reported to this survey, their opportunity for participation in activities consistent with their play interests were few. The physical limitations of the child were acknowledged by the school, but the responsibility for helping him to find activities which were modified in action but were equal in social value was not accepted.

An inquiry into this phase of the school program was attempted by questions relating to the child's recess activity, play or recreational interests, and his hobbies. Three aspects of selectivity seemed to govern the recess activity: the spastic child's associates were usually younger children; the passive role was frequently assumed; play was individual or with one other child. Many children were reported to show a real interest in group play but their lack of skill, their easy fatigue and their inability to adjust to group competition encouraged isolated activity, aimless wandering or envious watching. The special schools were able, to a greater extent than the regular schools, to plan play periods appropriate to the skills of the children with cerebral palsy. The hobbies and out of school interests present a list similar to that for non-spastic children except in regard to air plane models. The motor skill required is more precise than the spastic child is capable of acquiring.

III. Programs in Other States for Children With Cerebral Palsy

A. State programs.—That there is a developing social consciousness of the needs of the spastic child is shown by the increasing num-

ber of state programs and the amplification of the existing ones. Twenty-seven states now have limited programs under public or private operation for the education and treatment of children with cerebral palsy. Of the different types of state programs, four may be noted.

1. Beginning programs with emphasis determined by the individual situation.—Alabama, for example, now provides[27] "the services of a specialist in a school for motor re-education established in Birmingham. A great deal was accomplished for a limited number of children through this institution."

A recent report by Klaes[28] describes a program in Delaware where sixty-nine children with cerebral palsy are registered. Annual clinics are conducted in locations selected for the convenience of local physicians in order that they may observe and co-operate with the specialist in the field.

In February of 1944, the Society of Crippled Children in Washington D. C. opened free, monthly consultation centers with Winthrop M. Phelps in charge. It is estimated that there are 200 cases of cerebral palsy in the District. This Center has facilities for examination of twenty-four children each month.

2. Programs which emphasize parent education.—Oversolicitude probably remains the greatest of home problems in relation to children with cerebral palsy. Jones[29] reports the organization of a state center in Wyoming designed to serve a rural population and to give emphasis to family education. Co-operating with the orthopedic surgeon and a trained physiotherapist are the state and county departments of public welfare which give assistance in the temporary housing of the patient and his parents who spend a few hours on each of five days at the center for observation and training in the simple therapeutic exercises. The State Department of Education provides assistance in the mental testing program. When the child returns home the parents know how to help him with the prescribed exercises, and the referral worker makes occasional visits to check on progress. Home instruction is provided by the State Department of Education, and modification of the school routine of children in the public schools is directed by the Division of Special Education.

3. Programs of correlated services in special centers.—In the programs of the few established cerebral palsy centers in the United States, the fundamental principle is the integration of the medical and educational services. The focus in these centers has been on research. The progress observed in the patients confirms the values theoretically attributed to the plan.

4. Programs including teacher training.—Michigan has made a worthy attack on the teacher training aspect of the problem. Two teacher training institutions, Wayne University in Detroit and Michigan State Normal College in Ypsilanti, are now including special courses for the teaching of children handicapped with brain injuries.

B. School programs.—Early education of the physically handicapped has received considerable emphasis within the past few years, resulting in the establishment of nursery schools adapted to crippled children. It is believed that the values of such units are reflected in the progress of the children. From one school in New York the teacher writes that the children's "knowledge of language was definitely increased so that they were better able to understand what physiotherapy was trying to do for and to them. Hence, in addition to responding to directions, they were more co-operative."

A successful program in which the focal point is the school with the educational and physical training programs well integrated is demonstrated by the Spalding School in Chicago. This school serves children who "by reason of disease, accident, or congenital deformity cannot attend a regular school with safety and profit during the period of their physical rehabilitation, simultaneous mental development and social adjustment". One of the long time values of this program is to be found in continuity of planning and the graduation of adjustment possible for the spastic child. An outstanding feature is the nursery school maintained for spastic children in the school building.

Another emphasis of this program is the extension of the Spastic Division so that the children of school age who do not have the social skills necessary for attendance in a reg-

[27] *Services for Crippled Children*, Children's Bureau Publication, No. 258 (Washington: Government Printing Office, 1941), p. 48.

[28] Mary M. Klaes, *Services for Crippled Children in Delaware* (Dover, Delaware: Delaware State Board of Health, 1942).

[29] Margaret H. Jones, "Wyoming Plans for its Cerebral Palsy Children," *The Crippled Child*, XX (August, 1942), pp. 41–2.

ular class may have opportunity to acquire them. The attention may thus be directed to the peculiar needs of the spastic child. When he is socially capable, he may enter the classes for the physically handicapped. Thus when a child is capable of benefitting from association with other children, he is in a position to receive it; when his lack of control would embarrass him and repulse others, he is with a group who understand his unco-ordinated movements. In whichever group he may be classified in school, the schedule of muscle relaxation and re-education will continue to be adapted to the child's needs. In evaluating this program, it would appear that with attention directed toward a physical program commensurate to that of the academic schedule, the child with cerebral palsy is given his proportional opportunity to learn to adjust to his world.

These various programs are suggestive for California's planning for the education of the children with cerebral palsy. The programs show the need for a distinct legislative and educational category for children with cerebral palsy; they indicate the value of an integrated program that correlates physical training with academic learnings; they constitute a challenge to education to function positively in the formulation of methods and techniques appropriate to the deviations reported for spastic children.

IV. Analysis of the Educational Facilities in California for Children With Cerebral Palsy

A. Legislative authorization and existing types of educational facilities.—Relative to an enumeration of the physical and mental characteristics as they are reflected in the academic problems of the child with cerebral palsy is an investigation of the facilities in California and the adjustments made in the program for the spastic children who were attending school. Three specific services are contributing to the benefit of the group: medical and social agencies; social and educational legislation; special education facilities.

1. Social agencies.—It seemed appropriate to inquire regarding the organizations which are active in contributing to or co-operating with the school in the care of spastic children. A detailed description of their activities is not pertinent to this study, but their wide influence, diversity of function, and far-reaching results need to be acknowledged. An extensive list of these separate agencies could be compiled if all local units were to be named. It seems feasible to suggest three groups in which the co-operating agencies reported may be included. The Department of Public Health and the Crippled Children's Commission functioning through the state or local units, school health departments, hospitals or clinics were reported by various school groups. The Society for Crippled Children and the Spastic Children's Society are active through the state and local groups. The recent law[30] permitting the spastic child to attend school at the age of three years is an example of the effective work of the Spastic Children's Society.

Fraternal organizations such as the Kiwanis, Rotary, and the Shriners were also reported by many schools for their support of the work directed toward the benefit of crippled children. The Shriners' Hospitals for Crippled Children, spending approximately one million dollars annually through the national organization, are organized to treat[31] "only the children of parents who are too poor to pay anything for the services we render. There are no restrictions on account of race, color or religion."

A third group is composed of departments of the educational system as, for instance, the bureau of child guidance or the psychological clinics. Briefly stated, these departments function to adjust school programs and to refer children to other agencies for necessary treatment or care beyond the scope of the school.

2. Legislation: Social.—Two basic points of interest have been responsible for legislation directed toward the education of handicapped children: medical care as a social measure with related services secondary to it, and specific educational aid. Medical and social assistance is provided to the handicapped child through California's Crippled Children Act of 1927. This act gives to the Department of Public Health the authority to provide necessary treatment for crippled children at county expense. Parental consent is required, and independent county programs function in many areas. Inequalities exist in the counties because of the varying child pop-

[30] *Education Code* (Sacramento, California: Bureau of Printing, Documents Division, 1943), Article 9609.

[31] *Shriners' Hospitals for Crippled Children* (Portland, Oregon: James, Kerns & Abbott Company).

ulation and financial resources. The Federal aid provided by the Social Security Act in 1935 is a factor in equalizing this load.

During the fiscal year 1943, Federal funds available for the state of California for services for crippled children under the conditions of the act were $153,562.81. An additional amount of $97,898.81 was received from one fund which requires matching and $55,664.00 from another fund which does not require matching. Beginning about 1938, the emphasis in California was on the use of Federal money for treatment of crippled children in rural areas. According to Mills "Children of migratory workers are considered as non residents, therefore Federal funds are used for migratory groups. A shift since the war has been migration to and within urban areas and, therefore, will require change in the emphasis of the program". These Federal funds are administered by various agencies in the different states. In California they are administered by the Crippled Children's Commission.

3. Legislation: Special education.—Legislation has recognized special education for crippled children as an essential part of the public educational system.[32] Special education is directly planned for the orthopedic crippled child, and although the spastic child is included in this grouping, he cannot be considered to share equally, since the adjustment of school facilities is planned primarily to meet a different type of disability. A traction patient or a child who cannot walk without crutches but has no speech nor motor impairment of the hands has markedly different needs in an educational program from those of the child who falls easily, who speaks indistinctly, or whose general muscular coordination is confused.

Table VI shows the classification of the 798 children with cerebral palsy who were reported to this survey by age and school or institutional placement. A smaller number of these children were enrolled in the regular public school, 134 as compared with 346 in the specially adapted units. A large number of the group in the regular school show only a minor degree of involvement, and it is a likely assumption that many children in the regular school who demonstrate a very mild type of cerebral palsy were not reported.

[32] *Educational Code* (Sacramento, California: Bureau of Printing, Documents Division, 1943), Chapter 9, pp. 9601–9617.

TABLE VI

AGE—TYPE OF SCHOOL PLACEMENT

Age—Years	Regular School	Special School	Special Class	Home Teacher	Hospital Teacher	Private School	State Institution	State Schools	Not in School	Total
Below 3									8	8
3–4	1	2							11	14
4–5		11							9	20
5–6	3	3	1						7	14
6–7	8	16	4		1			1	8	37
7–8	10	18	7	2					10	47
8–9	10	16	6	2					5	39
9–10	11	20	9	3					5	48
10–11	10	20	5	5					3	43
11–12	8	25	3	1					3	40
12–13	8	20	8	1	1				0	38
13–14	17	13	2	4					5	41
14–15	10	18	5	1					5	39
15–16	9	14	1	6	1				3	34
Over 16	23	41	5	5					15	89
Age not stated	1	1		1					2	5
Total	129	238	56	31	3	54	186	2	99	566
Total	129	238	56	31	3	54	186	2	99	798

TABLE VII

TABLE OF SCHOOL TRANSFERS

		Within California	From Out of State
From Regular School To	Special School	52	7
	Home Teacher	1	3
	Regular School	18	8
From Special School To	Special School	17	6
	Home Teacher	1	1
	Regular School	10	--
From Home Teacher To	Special School	23	3
	Home Teacher	--	--
	Regular School	1	--
From Institutions or Private School or Parochial School To	Special School	12	--
	Home Teacher	1	--
	Regular School	6	--

The study of school transfers, Table VII, indicates that there are an appreciable number of children for whom the suitable school selection was not made the first or second time and that, for some, even the present placement is one of necessity rather than of adequacy. There is evident in this table a trend toward the special school. The out-of-state transfers totaled approximately thirty-five from nineteen states, suggesting that families with handicapped children do not, perhaps, move from state to state readily.

4. Special schools.—Provision is made in California for state educational aid in meeting the excess cost of establishing special schools and classes for the physically handicapped children residing within the state.[23]

Sunshine Orthopedic School in San Francisco has forty spastic children in a total enrollment of less than 100 children. In this school a special spastic group is formed of those cases whose degree of physical involvement is extreme. During the school year of 1942–43 there were three children in this group. These children are taught separately, but their routine is planned within the regular schedule. The policy of the school has been to place the spastic child in the class with normal-speaking children for the benefit of hearing them talk and for the opportunity of conversing with them. Drill in phonics is given to all children in the school. Forty children are given daily speech correction from trained therapists. Speech and writing are noted as the two problem areas in the academic program. Class groupings are small so that individual instruction is possible for most of these cases. Music is encouraged and time allotted to it, but it is not planned as a specific program for the spastic children.

The daily routine is planned first with the consideration of the health routine, and second, of the academic schedule. There is a physiotherapy program but it is limited to those children whose doctor specifically ordered it. During the school year 1942–43 there were only ten spastics receiving physiotherapy services. The physical training program has not been generally recognized as an integral part of the education program for the spastic child. There has been an attempt to adjust the program to the child's motor abilities. The policy of the school has been to deter the child from any course of study that the teacher may consider contraindicated by his physical limitations. This is contrary to the approach suggested by Donaldson's[24] study which allows each child his choice of study sequence until it is evident to him, as well as to the teacher, that the skills required are beyond his abilities.

Sunshine Orthopedic School provides an elementary school program. The emphasis of a correlated program to teach physical skills at an early age is lacking. There are no facilities for the preschool spastic child. The regular high schools have health class units so that limited adjustments in the program can be made for the spastic child who can proceed to the secondary school. Questions on the questionnaire which related to the special training for the teachers of children with cerebral palsy were all answered in the negative.

[23] *Ibid.*, Articles 5151.1, 6954, 7106, 7138, 9641, 9642.

[24] Alice A. Donaldson, *Research Study in the Field of Individual Differences*, Institutional Bulletin, No. 23 (Elyria, Ohio: National Society for Crippled Children, 1939).

Another special school is the Washington Elementary School for Crippled Children in Los Angeles, where there were ninety-two spastic children enrolled at the time of filing the questionnaires for this survey. An additional twenty were receiving home instruction. Special provision in the physical facilities is made by use of large tables, wheel chairs, ramps, wedge pillows, stools, canes, and walkers. Though these modifications are routine to the school, there are seventeen children who were unable to fit into the program and who needed further adjustment.

Special classroom procedures were reported: manuscript writing or typing was substituted for cursive writing; the amount of work was modified to fit the individual; and, remedial room placement arranged for twenty pupils. Corrective physical exercises replaced a physiotherapy laboratory in order to provide active rather than passive exercise: bars for gait work, bicycle jig saw, tilted balance board, stall bars, swinging bars, and tricycles. Correlated with the exercise program are the activities of the craft room which are planned according to the motor need of the child. Woodworking tools, treadle and hand sewing machine, lacing and tying shoe, and hand and foot looms all contribute occupational interest to the muscle re-education program. The teacher and attendant supervise the child's activities very closely and encourage independence and effort. Each child receives about two and one half hours of this type of exercise each week.

Other specialized instruction includes speech therapy for thirty-nine pupils. Approximately one hour per week is provided each child by a trained speech teacher. Individual instruction, approximately one hour per week, is available for pupils as it is needed. Victrola records are used in the physical exercise program to encourage rhythmic co-ordination in walking.

A generally pleasant atmosphere prevails between the pupils and congenial relationships between the pupils and teachers. The teachers in this school have for the most part had some special training for this particular field of teaching. Course work reported included areas of human and comparative anatomy, kinesiology, abnormal psychology, and mental hygiene. Several teachers had had training in occupational therapy. Clinical experience in orthopedics with some emphasis on work with spastic children was also reported for several teachers.

The school program for spastic children in Los Angeles reaches the largest number in the elementary grades. Building upward from the elementary level in the total program is the high school organized for physically handicapped children. Greater personal competence is required for children in attendance at the high school. The routine is, however, adjusted to the limitations of the child's handicap. Rest periods, substituting for the one hour of physical exercise required by the state and nutritional service for all pupils. At the time of filing the questionnaire, eleven pupils were in attendance and eleven pupils were receiving home instruction. There is no physiotherapy program at the school but the pupils who are receiving treatment are excused from classes. Speech therapy is provided for eight pupils in classes for speech correction. Each child receives approximately one and one quarter hour individual instruction per week. Typing is substituted for hand writing. The special training for teachers in this secondary school has had an experiential emphasis in hospitals or in special schools.

5. Special classes.—In communities where school enrollment does not warrant the establishment of a special school, classes can be organized in which the curriculum can be adjusted to the needs of the typical child. The present trend in the educational programs for spastic children is toward separate classes. There are twenty-seven children in the spastic class in the Jefferson School in Oakland. Criterion for admission is readiness for academic learning. Transportation to school is by taxicab. The cab drivers carry to and from the cab those children who cannot walk. Special physical facilities are provided and additional rest periods, nutritional service and supervised feeding are common for the group.

Special speech work is provided for nine of these spastic children with others receiving therapy under private supervision. Assistance from the regular teacher and conversational experience with the group augment the speech program. There is no physiotherapy program though one was provided when the class was organized. Facilities for physiotherapy treatments are in the school building and it is anticipated that this service will be resumed when more therapists are again available for

civilian needs. A music program providing rhythmic exercises for co-ordination and dramatics is planned for one hour per week. Occupational therapy also supplements the physical program.

This school program ends with the elementary school, though the age range of the pupils is at present in excess of the usual elementary or even high school age range. For some of these pupils no academic experience was available until the class was organized.

6. Hospital classes.—Provision for a hospital teacher was[35] reported for eleven spastic children at the date when the questionnaires were answered. Robert, aged fourteen, is one example of the children receiving this instruction. He was rated as doing good work in all subjects except arithmetic which was fair, until he was promoted to the fourth grade. Then he was hospitalized but with a hospital teacher was able to continue his lessons and returned to school able to join his regular class.

7. Home teacher.—Table VI shows thirty-one children reported to this survey who were receiving home instruction. The advantage of home instruction is realized and California is recognized as one of only six states in which it is a compulsory type of instructional service to be provided for the children who cannot take advantage of school facilities. The limitations of home instruction programs are not always fully realized in their significance to the child's total development. Carlson[36] summarizes these in the contrast with the school situation: ". . . the child had not competition and hence no chance to attain the psychologically vital sense of personal worth. Also he had no opportunity to accustom himself to the new situations that he must encounter some day. And finally, these home teachers were available only for children over six years and with the spastic it is important to start training at a much earlier age".

Examples were also reported of children who could not have suitable opportunities within their own districts but for whom adjustments could be made within regular school channels by issuance of inter-district permits.

8. Free transportation.—Legislation has also made possible free transportation for pupils[37] whose physical handicaps prevent their walking to school. Twenty-eight schools reported having children enrolled for whom transportation was necessary. The need varied from complete inability to walk to limited ability. For the most part, the regular schools reported using the school bus and the city bus. Some spastic children were permitted to use the regular school bus for even a short distance. For one child, for example, it was only a few blocks. In two instances the teachers were expected to use their cars to transport the spastic children. Parents were reported by eight schools as the ones to take the responsibility. Two children, one a girl of twelve and another a boy of fourteen, used their three-wheeled tricycles.

9. Preschool units.—A third type of aid to special education is represented by the permissive legislation which allows children with cerebral palsy at the age of three to attend schools maintained at public expense.

Probably the first reported school for spastics of preschool age operated by the Board of Education is the Cottage School in Oakland. This school is housed in a portable unit on the grounds of the Children's Hospital, and the needed services of the hospital are available on a co-operative basis. [38]There was started in 1940 the "Cottage School for Spastics operated by the Oakland Public Schools on the grounds of the Children's Hospital of the East Bay. Here these children are under the direction of a teacher trained in the education of young spastics, with physiotherapy treatment provided by the hospital at rates within the parents' capacity to pay. Lunches are served by the hospital at a nominal charge. Free transportation (taxicab with a mother in attendance) is provided by the school system."

The physical facilities of this unit are adapted to the spastic child with limited motor skill. Swings, with a seating arrangement for the child who cannot sit unsupported, acquaint him with new sensations of motion which assist him in locomotion. The chairs on rollers for those children who cannot walk, ramps and a playground with a cement floor which facilitates the use of wheel equipment make an outdoor program avail-

[35] *Education Code*, op. cit., Article 9604.

[36] Earl Carlson, *Born That Way* (New York: John Day Co., 1941), p. 139.

[37] *Education Code*, op. cit., Article 9607.

[38] *Spastic Children's Society* (Oakland, California: Children's Hospital of the East Bay).

able to the child with nominal effort for the staff. The capacity of the school is reached by the present fourteen in attendance. To date, sixteen children have graduated from this program to the spastic class in a regular school.

The need for a similar preschool unit in Los Angeles was recognized by the Spastic Children's Society of that city and shared by the personnel of the school for crippled children. There were reported to this survey twenty-four children of preschool age who had cerebral palsy. Of that group, it is known that two can walk, three can talk and seven can both walk and talk. The school for crippled children with its present equipment and staff cannot accommodate children under six years of age or those who do not have a reasonable degree of competence in locomotion and in personal habits.

Legislation has made possible the many educational services for the atypical child. More specific assistance is needed to establish a program for the child with cerebral palsy. A beginning has been made in legislative measures. This has been followed by the establishment of spastic units. There is, however, little continuity in the program from one age period to another, since a class is formed for the age group in which there are the largest number of spastic children in the community. These classes also lack permanence in that the program may be discontinued at any time that the number of children with cerebral palsy of that age group do not warrant the expense and no substitute may be available. The optimistic note is in the beginning of public consciousness toward the need for spastic units in the total educational program.

TABLE VIII

SUMMARY OF GROUP QUESTIONNAIRE

Question	Unanswered	Yes	No
Is individual instruction provided for children with cerebral palsy?	4	24	77
Is special work in speech given?	3	37	65
Is a specially trained speech teacher employed?	31	29	46
Is any other substitution or remedial type of instruction provided for children with cerebral palsy?	6	26	73
Do you have a physiotherapy program?	6	4	95
Do you have a planned program of music for children with cerebral palsy?	10	6	89
Are the children with cerebral palsy able to fit into the regular school program?	9	77	31
Have adjustments been made in the school routine?	25	41	39
Has special provision been made in the physical facilities to accommodate such children?	14	20	71
Have any teachers had special training for working with children with cerebral palsy?	7	10	88
For working with other crippled children?	39	6	60
Do the children with cerebral palsy have any specific academic problems that you consider directly related to the handicap?	25	51	29
What is the attitude of the regular classroom teacher toward the child with cerebral palsy?	16	Answered 89	Answered
What is the attitude of the other children toward the child?	12	93	Yes
Can the children with cerebral palsy play with other children to any extent?	11	75	20
Are conferences held with parents of children with cerebral palsy			
Before they enter school?	26	62	17
After they enter school?	18	80	7
Is special transportation needed for any of these children?	12	28	65
Are you carrying on or participating in any experimental study pertaining to children with cerebral palsy?	15	7	82
Is there a preschool unit for children with cerebral palsy in your locality?	15	5 (Two schools only were named)	85

B. Results of the questionnaire and interpretation.—In an analysis of the school programs in California for the children handicapped with cerebral palsy it seemed desirable to investigate two aspects: the modifications of physical facilities; and the adaptation of educational techniques.

Information regarding adjustments in the programs for spastic children in the schools in California was received from detailed questionnaires from 105 school districts. These are summarized in Table VIII. The response to the questionnaires indicated that the pupils with a mild degree of disability are the ones attending the regular schools. An example is from a regular school in Berkeley: "This child's spasticity is so slight as to permit his doing everything the other children do". For such children the general educational system provides adequate educational opportunity. For other cases with a greater degree of involvement the present modification of techniques and facilities in the present school programs appears inadequate.

1. Individual instruction.—In the twenty-four schools providing individual instruction there were reported eighty-seven children with cerebral palsy so that in relation to the total number of spastic children who were enrolled in school, only 20 per cent were given this necessary assistance. The number of hours allotted to spastic children for this assistance is shown in Table IX.

TABLE IX

TIME ALLOTMENT FOR INDIVIDUAL INSTRUCTION

Hours per week	Number of Schools	
	Regular School	Special School
Less than 1	1	
1–2		2
2	3	2
3	1	
4	1	
5	2	1
3–5	1	
More than 5	1	1

The degree to which the regular schools can provide individual help appeared, from the reports to be automatically limited by the pupil-teacher load. Children with a disability resultant from a cerebral lesion cannot proceed at group pace; they cannot learn by general presentation of material; they cannot adjust to the general tenor of a class of many pupils. For such reasons the small class with individual help is important to them. The special school is organized so that "Teaching is on an individual or small group plan within a multiple graded class . . . classes are limited in enrollment between fifteen and twenty pupils". With a group of that size a child can proceed at his own pace and receive help when and as he needs it. The limitations necessitated in enrollment in these schools needs to be recognized because it is this factor which determines the horizontal range in the number of children who can be helped. Table X shows the distribution of the sizes of groups in the regular school, the special school, and the special class in the regular school. In a few cases, as of the one or two-room school, the number of pupils in the room under one teacher was accepted rather than the class size, since it is among the entire group that the teacher would need to distribute her time and attention. In the city high school, where the enrollment of a 10th grade, for example was several hundred, the class grouping for instructional purposes was the one selected for comparison.

TABLE X

DISTRIBUTION OF SIZES OF GROUPS FOR CLASSROOM INSTRUCTION

Number in Class	Type of School Number of Classes	
	Regular School	Special School or Special Class
5–10	4	61
11–15	14	54
16–20	14	12
21–25	12	35
26–30	21	33
31–35	24	--
36–40	36	--
41 and over	7	--
Total	132	195

2. Speech training.—The incidence of speech defects among the children with cerebral palsy is proportionately much greater than the facilities for speech therapy in the schools. The urgency of speech training for the spastic child, if he is to evidence his mental ability or have speech as a tool in learning, places upon the school the responsibility of providing corrective speech work at an early age. Of the 457 spastic children enrolled in the public schools in California, 100 children or 23 per cent were receiving "special work in speech". Thirty-seven schools were offering speech training, and twenty-nine schools had trained speech teach-

ers. Many schools recognized their lack in this respect as evidenced by comments volunteered on their reports. It was indicated that some spastic children were receiving private speech therapy.

3. Physiotherapy.—The spastic child's difficulty in co-ordination has a special significance to school attendance and academic learnings. Physiotherapy as an integral part of the school program may seem a new idea but is, nevertheless, consistent with a plan that is aimed at providing a functional education for children with cerebral palsy. Four schools reported having a physiotherapy program for the spastic pupils. In these schools there were four trained physiotherapists, two for full time and two for part time.

One outstanding example in California of the integration of physical training with the school program is the Cottage School in Oakland. The schedule for each spastic pupil is planned jointly by teacher, physiotherapist and doctor. The physiotherapy department in the hospital adjoining the school building is available for these preschool children. One special school in Los Angeles was mentioned as having a corrective physical education program as a substitute for physiotherapy. Craft classes function as occupational therapy with activities planned for the exercise need of each child.

These are examples from schools for crippled children. It seems consistent that the regular schools which could not arrange for individual academic instruction would not be able to provide for individual physical education or corrective exercises which require individual attention. It was indicated on the questionnaires that the only alternative of many schools was exemption of the cerebral palsied child from physical education classes. That physiotherapy is recognized as essential for the spastic child is evidenced in the adjustment of the school routine for those children who are scheduled through some agency for physiotherapy services.

4. Special music program.—Music fills a need in the education of the spastic child quite distinct from that in the program of the regular school. It has a therapeutic value in producing relaxation which is the keynote of the general treatment for cerebral palsy. One experimental program in Chicago which provides a period of fingerpainting accompanied with soft music reports marked improvement in the child's ability to speak immediately following the hour of music.

Six schools reported a program of music planned for the spastic pupils. A basis for the selection of the instruments to play was the consideration of the physical action needed to produce the sound; for example, the "horns used for blowing". The music program of the special schools showed an emphasis in rhythm and rhythmic activities. Rhythmic tunes and exercises were stressed for the purpose of encouraging smooth and co-ordinated movements. One high school reported playing phonograph records during a typewriting class as an aid to regularity in the typing movements. Another special school used recorded music as an aid to develop rhythmic co-ordination in walking. Marked progress in this motor skill was noted for the group of girls who had practiced walking to music during their year in school.

In the regular schools the practice seemed to be to provide a general music program open to the spastic child wherever his abilities allowed him to share in it or wherever his disability did not interfere with it. Private piano lessons were reported for many handicapped children. Piano playing was encouraged for the distinct purpose of developing better motor control. It appeared that the rhythm and muscular exercise contributed toward smooth and regular co-ordination.

5. Adjustment in time schedule.—Consideration of the time factor in the planning of the child's schedule previously noted as a problem of slowness in the instructional program, is reported by many schools as important for the spastic child. Typical examples are as follows: adjust length of work periods; programmed for comfortable position of rooms so time will not be lost between classes; adjust recess and child comes in alone because cannot march with the group.

6. Modification of physical facilities.—There were twenty schools which indicated that special provisions were made in the physical facilities to accommodate the spastic children enrolled. Of the seventy-one which indicated that none were made, fifteen volunteered the comment that for the pupils in attendance, further adjustment was not needed.

In describing the changes made, it appears that the modification of equipment has been primarily that which facilitates locomotion.

A larger number of special schools reported specially constructed equipment whereas the regular schools rearranged that which they had.

Eighteen different items of special equipment were reported by the special schools in contrast to four different ones by the regular schools. Walkers, ramps, and special seats were most frequently reported. The two lists follow:

Regular School	Special School
Special Chairs	Special Chairs
Special Seating Arrangement	
	Adjustable Seats
	Wheel Chairs
Space for wheel chairs	Space for wheel chairs
Ramps	Ramps
	Ramps—portable for wagon
	Walkers
	Hand rails
	Parallel Bars
	Foot rests
	Carryall
	Shoe skates or skiis
	Mirrors
	Rooms on one floor
	Wider doors
	Rest Period
	Nutrition
	Socialized Work Room

These various educational techniques exist as adaptations of method in the regular schools; in the special schools they are more generally the routine program since the schedule in these schools is planned for the handicapped child.

In summary, the adjustment of the instructional program appears very inadequate in regard to the number of children with cerebral palsy and the characteristics of the disability.

7. Private schools in California with reference to children with cerebral palsy.—Many parents have tried unsuccessfully to solve the problem of the education of the spastic child through the private schools. The problem is too big and becomes too expensive for the average family.

Fifty-one spastic children were enrolled in fifteen private schools. The largest group was at Hillside House in Santa Barbara. Hillside House is a home school for children with cerebral palsy. The capacity of twenty with a waiting list of eighty illustrates the need for this type of school. The next size group was eight at Williams School in Pasadena. Another school had four, another three, and the remaining had one or two. Each of three private schools reported knowing of one spastic child in the vicinity or previously at the school in addition to the fifty-one pupils.

The individual reports on the children in attendance in private schools indicate problems similar in nature to those reported by the public schools. In both the public and the private school situation the spastic child was reported to need individual attention, special help, and adaptation of techniques. Also the reports of both groups showed similarity in areas of academic difficulty, in range of handicap and in need for adjustment of educational program.

C. Evaluation of the school program.—It is obvious that the school program in California is developed to a high degree. Despite the fact that five types of instructional programs exist (Table VI) in which the cerebral palsied child may share, there is no program of elementary or secondary education planned for children with a cerebral lesion. For that reason, only a small percentage of children with cerebral palsy are receiving an appropriate education, and many of them are without any educational opportunity. There is lacking in the school services a program which will provide training to help the child to acquire the motor skills of social living and self-help without which academic learnings are not functional.

From a study of the educational facilities in California for the spastic child in relation to the educational problems he presents, there are five areas in which amplification of the programs is essential:

1. Facilities for physical care with educational opportunity.
2. Integration of physical training with the academic program.
3. Preschool programs.
4. Trained personnel for the specialized instruction.
5. Opportunity for social learnings.
6. Family education.

1. *Need of facilities for physical care with educational opportunity.*—Many of the children reported (Table VI) who are not receiving any instruction and many who were not found through this survey are those with such severe physical involvements that they are not ready for academic learnings. In

homes where the presence of the child is a cause of family tension, adequate physical care with opportunity to learn the basic skills of personal confidence is not available. The physical appearance and the helplessness of the severe spastic child may strain family relationships to the breaking point. Numerous examples similar to the following were reported to this survey: M7 is almost nine years old. He was enrolled in a regular school but has had a home teacher as he was too nervous to attend regular classes. He is doing good work. His motor control of legs and feet is better than of hands and arms. He runs, plays ball, dresses himself, but spills most of his food when trying to feed himself. His mother took the younger child and left home. M7's grandmother has taken care of him.

2. *Need for integration of physical training with the academic program.*—The value of an integrated program of physical skills has been pointed out and a beginning in the development of such programs has been observed. Examples of children for whom such a program would be a worthy experiment are similar to B6 who is seven years old: He has had no instruction to date. He has beginning speech, is very near to walking alone and can follow directions. The doctor stated that the child's chances are very good with proper training.

Doll[39] considers it important that education contribute to the techniques and motivation of teaching speech and the motor skills. He writes, "If the child is to receive muscle training, it is of the utmost importance that such training be correlated with education methods so that the motor progress can be capitalized for expressive purposes".

3. *Need for preschool program.*—Though legislative action had made school admission permissible for the spastic child at the age of three years, there were only two such programs indicated in the replies to the questionnaires. It is known that plans are being made in other areas in California for similar units, but the number of children accommodated remains small.

The spastic child's first learnings are not of an academic nature but are physical skills as speech facility and motor habits, and social techniques. It is important to begin these learnings early so that academic learnings may follow without a marked retardation. The developmental sequence of the spastic child will have a slower tempo and be dependent upon basic physical responses.

4. *Need for trained personnel.*—The response to this survey indicated a very real lack in the numbers of teachers trained to work with spastic children.

5. *Family education.*—Important in the establishment of an appropriate program for these children are conferences with the parents so that they may understand the educable potentialities of the child in regard to his limitations as well as to his capacities. Sixty-two schools reported having conferences with the parents before the child entered school and eighty schools had conferences after the child was enrolled. It would seem equally essential if the school program is to function successfully that the school personnel understand the parental attitudes toward the child's handicap, toward his school relations, and toward his position in the family group. It seemed, therefore, apropos to inquire regarding the parents' attitude toward the child's handicap. The attitudes, as reported, varied greatly, but some general groupings may be suggestive in a planning program for the child with cerebral palsy:

Constructive Sympathy:

Both parents are very co-operative and give child well directed tutoring at home so that he is one of the best informed children in the school.

Constructive—mother works with speech, father helps with exercise and walking.

Oversolicitude:

Parents have become old in their absolute unselfish devotion.

Sympathetic but inclined to over-protect him—waits on him as though he were a baby.

Family Adjustments:

Parents have adjusted their lives to develop the best in their son.

Both parents are very co-operative and give intelligent tutoring at home so that he is one of the best informed children in the school.

[39] Edgar A. Doll, "Behavioral Consequences of Cerebral Birth Lesions," *Journal of Obstetrics and Gynaecology*, XXXI (May, 1936), p. 870.

Positive Attitude from Relatives:

Father dead; mother has a new family. Child lives with grandmother.

Mother has not accepted it; grandmother accepted it as a challenge.

Step-mother has no control, mother deceased, child lives with aunt, sister takes care of her.

Parental Differences:

Child takes advantage of handicap; father too lenient; stepmother is too severe and does not let boy use handicap to get out of doing things.

Father still finds it hard to accept; mother accepts and father co-operates.

Parents disagree; child likes home in which parents have placed him.

Future Planning:

For girls: primarily social limitations.

She is a twin, resents handicap. Parents do everything they can for her, socially and otherwise.

The girl is discouraged socially, cannot do the things she wants, parties, etc.

For boys: primarily occupational limitations.

Attitude is good but planning for child's future (they) have not realized his limitations.

Co-operative but mother is inclined to expect too much of him.

6. *Need for opportunity for social learning.*—School experiences assist the child to gain individual skills, to find compensatory activities and to develop a favorable attitude toward recreational life. A home teacher from one city district summed up the situation for the parents of the four children in her territory and echoed the wishes of other parents: "The four children accounted for in this report have home instruction two hours per week. The parents seem grateful for it but all feel that much more schooling and advantages such as being with other children should be provided for these handicapped children". Considering the total number of children receiving home instruction, (Table VI) there are approximately 150 children with a similar social gap in their educational program. A combination of services has been attempted for a few children but the number thus assisted is small.

V. Recommendations for the Educational Program for Children With Cerebral Palsy in California

It is necessary in planning an educational program for children with cerebral palsy to consider the physical and the mental deviations consequent to the cerebral lesion. The educational prognosis is in many cases confused by the interrelationship of the motor and the mental defect. Wide variations of these conditions in regard to degree or type of manifestation may be considered as symptomatic of cerebral palsy.

Educational experiences which can be used by spastic children will show variations; therefore, it becomes necessary to define educational expectation for each child. The educational facilities previously discussed were in relation to the spastic child who was in school. The educability of the spastic children was, therefore, in relation to ability for academic learning. Educability of the spastic child may, however, be considered in relation to motor learning—that degree of mental ability which will enable the child to learn the basic physical skills. An emphasis is placed on the spastic child's acquisition of physical skills as a prerequisite for making academic learning a functional asset to him. A degree of academic success, even though limited, would be considered a criterion for the child's continuing in any long time educational program. There are spastic children for whom the final goal may be limited to the basic skills of self-help, but it is contended that there is a social obligation to assist them to the level of accomplishment that is possible. This variability in final goal as well as in symptoms has complicated the formulation of an educational program because no single type of instructional program may be considered appropriate for all children who have cerebral palsy.

The present practice of including the children with cerebral palsy in the school program of the crippled child has served effectively for some spastic children. There needs to be a distinction, however, in the thinking and the planning for spastic children because there are many for whom the regime of a school for children with all types of handicap is too demanding. The program, planned for the orthopedic cripple who shows a zero response to stimuli, will not be appropriate to the spastic child who gives a maximal re-

sponse to stimuli. Or in another situation, the crippled child may be passively helpless whereas the spastic child's helplessness may have superimposed upon it, confused, tense, or involuntary movements.

Thomas and Rogers[40] have summarized the educational needs of the child with cerebral palsy, "His problems are far more difficult than those of the crippled child. The crippled child can have the world brought to him. The spastic child must have his world adapted to him. To meet this, he should be given more, rather than less, education than the average child. He will need more strength of mind and more courage than the average child. He will need a stronger philosophy of life to be able to hold his own."

Fundamental to a program in which all spastic children may share is a separate legislative and educational category such as at present exists for the deaf and the blind child. A beginning has been made in the permissive legislation admitting children with cerebral palsy at the age of three years to such special schools or classes as may be available to him.

The evaluation of the educational facilities in California for children with cerebral palsy indicated that the modifications now made in the school program facilitated school attendance for a number of spastic children. There were other spastic children, however, who were considered to have academic ability but whose degree of physical disorder prohibited school opportunity under present conditions. In relation, therefore, to the total group of spastic children, three services appear essential in a plan designed to give all children with cerebral palsy educational opportunity commensurate with their physical and mental ability: (1) formulation of a state-wide cerebral palsy program with educational services having an integral function in the total plan; (2) continuation of the special education program for those spastic children for whom it is suitable or for whom adjustment can be made through the regular channels; and (3) establishment of additional educational facilities necessary for a correlated program for children with cerebral palsy.

A. The state program for children with cerebral palsy.—The major emphasis in any state program must be in the co-ordination of medical, surgical, neurological, educational, and social services. It is apparent from a review of programs reported by other states that an experimental approach is consistent with the present stage of the problem in relation to diagnosis, prognosis, or treatment.

The details of the organization of a state-wide program are not pertinent to this study. The educational program must be an integral part of the total state program for spastic children and may, therefore, be considered in relation to the field services as well as to the diagnostic Centers.

B. The educational program.—The formulation of an educational program on the basis of an analysis of the individual records of spastic children suggests certain areas of major points of emphasis. There must be an integration of services so that the children may have the necessary physical training to develop those motor skills without which academic learnings are not functional. There must be an emphasis on early training as an integral part of the program. The very young spastic child is totally dependent for care, and although his needs and desires approximate his chronological age, his motor skills are in conflict with them. The admission age to a school program, according to present legislation would be three years, but medical and neurological findings are in agreement that diagnosis and treatment should be instituted at as early an age as evidences of the lesion are observed.

There is necessary an emphasis on training teachers to work with spastic children. The skilled teacher is one trained in many techniques. There is needed family education in the care and treatment of the spastic child in the home. Teachers of spastic children emphasize the importance of a parent education program. It is often difficult for the members of the family to maintain an objective yet understanding attitude toward the child with cerebral palsy and his problems. He must receive help but not constant solicitude. He needs to have some things done for him, yet he must learn to do for himself even though the task is more difficult for him than for others. These distinctions are not easy for parents to make, but they are essential to the child's learning process.

Essential to the whole program is the recognition of the relation of the cerebral lesion to a mental defect. In many cases of cerebral palsy, motor disorders reflect the mental defi-

[40] Leah C. Thomas and G. Gage Rogers, "Spastic as a Child," *Physiotherapy Review*, XIV (June, 1934), pp. 60–63.

ciency and no amount of motor training will compensate for the basic lack.

If the educational placement is to be recommended by specialists in the diagnostic centers and in the field services, an increase in types of school facilities and in modification of instructional services would seem indicated. It is proposed that children with cerebral palsy be classified in four categories on the basis of physical and mental development, and educational programs planned which will be adapted in facilities and in techniques to the range of the characteristics of each group. The following four categories were suggested from a grouping of the cases referred to this study: Group I, children who can be served by the facilities of the special education programs as they now exist with added services for instruction in motor education and for establishment of special spastic units in schools for crippled children; Group II, children of preschool age who manifest varying degrees of involvement; Group III, children who require custodial care because of mental deficiency; Group IV, children who have a severe physical involvement or multiple handicap, but who evidence mental capacity greater than those children committed to institutions for the feeble-minded.

It is not expected that arbitrary division of these groupings will easily be made nor will it be essential. A feature of the total program would be that of flexibility to permit transfer from one unit to another if the child's condition shows change.

VI. Summary

The problem of the education of the spastic child is recognized as one of considerable magnitude. The study of the educational facilities in California for children with cerebral palsy was stimulated by legislative action. The data were collected by means of written questionnaires and supplemented with information obtained from personal observation.

Approximately 1,200 spastic children were reported by the school personnel. Detailed data were received for 798 children, of whom 475 were enrolled in the public schools. The majority of this group were between three and sixteen years of age. Research studies indicated that the incidence of cerebral palsy is not affected by economic, social, or geographical factors. The occurrence, therefore, of a constant case load should be of significance in educational planning.

Basic to planning an educational program for the spastic child is a consideration of the area and the degree of the motor disorder for which modification of facilities are required. The area of physical deviations reported were in locomotion, self-help, speech, and sensory handicaps.

The classroom teacher is confronted with the academic problems consequent to the cerebral lesion. There are certain types of problems which appear to be characteristic of children with this particular handicap in that they are common to the group in the special schools, but peculiar to the spastic child in the regular school. The main areas enumerated were speech, writing, reading, arithmetic, art, spatial relations, slowness, motor and emotional control, and group pressure. Marked overageness for grade was characteristic of the group.

The physical characteristics of the handicap complicate the evaluation of intellectual capacity. That the majority of the children reported to this study had an intelligence quotient above seventy, or were doing passing work or better, or on teacher's estimate were judged "educable" may be somewhat influenced by the sample, since the primary source of information was school records. It points out, however, that low mental capacity is not necessarily a concomitant of a cerebral lesion. In contrast, however, the 186 children reported from two institutions for the feeble-minded directed attention to the fact that the relationship of a cerebral lesion to mental defect must be recognized and not overshadowed with sympathy aroused by the physical symptoms.

The social interests of the spastic child as reported by the schools were similar to those of the non-spastic, but the school opportunities for social experiences were limited. Three aspects of selectivity were noted in the recreational activity of the spastic children: their associates were usually younger children; the passive or spectator role was frequently assumed; and play was individual or with only one child.

There are programs for children with cerebral palsy now functioning in twenty-seven states. Different emphases may be noted, with, however, overlapping: the initiation of the program in a limited area with

emphasis determined by the individual situation; family education; teacher training; school units; and a correlated program in the cerebral palsy centers. Common to all programs is the experimental approach.

Because the manifestations of the disability caused by a cerebral lesion are so varied, it may be concluded that no single type of instructional program is the solution to the problem. Five types of instructional services were reported in all of which children with cerebral palsy were enrolled. The records of school transfer were suggestive of the lack of suitable facilities for a number of children and showed a definite trend toward the special school.

The analysis of the responses to 105 questionnaires from school districts and 798 individual reports indicated certain areas in the school program for which increased services to the spastic child are necessary. There is needed an integrated program to provide the children with the necessary physical training for development of those motor skills without which academic learnings are not functional. There must be an emphasis on training in the preschool years to teach new motor pathways when the growth impetus is high and before wrong motor habits have been fixed. The reports indicated that there were few teachers in the California schools who were trained for instructing children with cerebral palsy. A program including family education is important to develop family attitudes that will be sympathetic yet not oversolicitous, that will give assurance of help when needed but encourage independence.

The composition of the sample reported to this survey must be recognized in drawing conclusions regarding spastic children as a group. The limitations of final goal of achievement for those who can master school learnings, the inability of many who evidence academic ability to a certain point in early childhood and then can progress no farther, and the mental defect of an appreciable proportion of the group are all directly attributable to the cerebral lesion. As such, they are significant in the educational program for children with cerebral palsy.

The children reported to this survey who were enrolled in school and who evidenced academic ability should have the opportunity of school experiences in an environment suitable to them and with techniques adapted to their disability. Because of the physical deviations characteristic of cerebral palsy, the spastic child of high grade mentality requires approximately the same care as does the spastic child of low grade mental status. The primary item of difference in the program for both groups is in the provision of the teacher and teaching facilities. In contrast to total expense, this would not be a prohibitive factor. Although complete social or economic independence is rarely achieved, the gains attained in the acquisition of social and vocational skills justify educational opportunity for the children with cerebral palsy who evidence ability for school learnings.

FACTORS AFFECTING THE LEGIBILITY OF HANDWRITING

LESLIE QUANT
Social Security Board
Washington, D. C.

PREFATORY NOTE

The paragraphs of handwriting which constitute the reading selections used in this study have been omitted in this printing, but may be found in the complete dissertation in the library of the University of Chicago.

INTRODUCTION

THE PROBLEM

The investigation here reported is an attempt to show how various factors modify the legibility of handwriting. The data are derived from an objective study of the eye-movements of subjects as they read paragraphs of handwriting. In this study legibility is considered as synonymous with readability. Legibility is not considered as a unitary characteristic, but is regarded as a composite made up of simpler elements. Dr. Frank N. Freeman in his Chart for Diagnosing Faults in Handwriting,[1] has selected five characteristics for measuring the quality of handwriting: (1) letter formation, (2) spacing, (3) alinement, (4) slant, and (5) quality of line. The present study will be organized around these characteristics.

As far as the writer has been able to discover, no previous attempt has been made to show how these characteristics enter into the legibility of handwriting. Investigators in the field have assumed that handwriting that presented a good appearance was legible, but no attempt has been made objectively to analyze handwriting to see how any of the factors which Freeman studied determines the legibility of a selection of handwriting. Breed and Culp[2] conducted an investigation to determine the relationship between legibility (quality of handwriting) and speed, based on the Ayres Handwriting Scale. They later suggested a weighting[3] for factors in the form of handwriting which make for legibility. The Pressey's made an investigation of the illegibilities in handwriting, in which persons who read the material were asked to note any letter formations that gave any trouble in reading. Illegibilities were check by the criterion[4] that "if they (the subjects) had to look twice at a word, they were to check that part of the word which gave them trouble."

In the present study each factor is considered separately from the other factors, in an attempt to determine the relative importance of each in the total composite which is called good writing or poor writing on the basis of legibility. The ease with which the handwriting can be read is to be considered through an attempt to answer the following questions:

1. What effect, if any, do variations in letter formation have on legibility of handwriting?
2. What effect, if any, does variation in spacing have on legibility of handwriting?
3. What effect, if any, does irregularity of alinement have on legibility of handwriting?
4. What effect, if any, does irregularity of slant have on legibility of handwriting?
5. What effect, if any, does the quality of line have on legibility of handwriting? (Quality is used here in a restricted sense, and refers to the weight of the line of writing.)

PROCEDURE

Derivation of the handwriting selections.— As a preliminary step the author observed the handwriting of numerous persons, in order to discover very good and very poor quality of handwriting. These individuals were then asked to vary their habitual manner of writing in certain respects. For example, a person who wrote with good alinement of letters was asked to write exactly as he would write normally, except that he would use poor alinement. If the individual wrote with poor letter formation, he was asked to improve this characteristic so that his writing would be

[1] Frank N. Freeman, "An Analytical Scale for Judging Handwriting," *Elementary School Journal*, XV (1915), pp. 432–441.

[2] Frederick S. Breed and Vernon Culp, "An Application and Critique of the Ayres Handwriting Scale," *School and Society*, II (1915), pp. 639–647.

[3] Frederick S. Breed and Vernon Culp, "Note on the Relation of Legibility and Form in Handwriting," *School and Society*, IV (1916), p. 872.

[4] Luella C. Pressey and Sydney L. Pressey, "Analyses of Three Thousand Illegibilities in the Handwriting of Children and Adults," *Educational Research Bulletin*, VI (September 27, 1927), p. 270.

changed only by having good letter formation. Otherwise his writing was not to be changed in any respect. Repeated trials with a large number of persons, both good and poor writers, showed that modification of one characteristic of handwriting results in some degree of accompanying changes in other characteristics also. If a person writes habitually with even slant, and then attempts to write with uneven slant, he alters the letter formation, writes with uneven alinement, or even changes the quality of line, and modifies the spacing between letters. This method of deriving samples of handwriting which would be comparable in all respects except one selected characteristic was finally abandoned as impracticable.

The next step was an investigation of a large number of samples of handwriting in an effort to locate, if possible, certain "types" of handwriting. Prospective Freshman students at the University of Chicago formerly were asked to submit, as a part of their personnel record, an autobiography in their own handwriting. A careful search through approximately 750 of these records revealed the fact that there are no "types" of handwriting. On the contrary, handwriting shows a great variety of individual differences from person to person. The poor handwriting in these records was usually poor in several respects, and the good writing was good in most respects. All possible variants of good and poor seemed to be present in numerous combinations. The attempt, therefore, to select samples of "typical" handwriting was likewise considered futile.

The author next selected a paragraph, designated in this study as Selection 2, produced in his habitual style of writing, with a medium-point fountain pen. After a period of intensive practice the writer found it possible to modify his own handwriting so that other selections could be written similar to Selection 2 in all respects but one. For example, one paragraph was written in which the letter formation was poor, but in all other respects (spacing, slant, etc.) the writing was of the same quality as the original paragraph (Selection 2).

In order that the difficulty of the content of the selections would remain constant throughout the study, the standardized paragraphs—"Peter's Dream"—were used.[5]

[5] These paragraphs were devised by Dr. W. S. Gray for testing oral reading ability.

The following selections were read by the subjects participating in this investigation:

Selection 1—a printed paragraph.

Selection 2—a paragraph of normal handwriting in the author's habitual style of writing.

Selection 3—handwriting with poor letter formation.

Selection 4—normal handwriting, but with reduced spacing between letters and between words.

Selection 5—normal handwriting with reduced spacing between letters, but with normal spacing between words.

Selection 6—normal handwriting, but with the spacing reduced to ¼ inch between the lines of writing.

Selection 7—normal handwriting, but with increased spacing between letters and between words.

Selection 8—a paragraph written with uneven alinement of letters.

Selection 9—a paragraph written with irregular slant.

Selection 10—a paragraph written with a heavy line.

Selection 11—a paragraph written with a light line.

Plates I to XI show the paragraphs used for this study. Selections 2 to 11 have been reproduced by mimeograph, and the lines of all selections have been separated vertically for ease of plotting the photographic records of eye-movement during the reading.

Further description of these experimental paragraphs of handwriting will show the extent to which they vary from the original paragraph of normal handwriting (designated as Selection 2).

Table I shows that Selection 2, with a total of 155 letters, has 148 letters that may be classified as having good letter formation—95 per cent of the total number. There is no objective standard by which letter formation can be judged to be poor or good, since the different handwriting systems in general use are not in perfect agreement, but in this study, any departures from accepted good form have been the criterion by which a letter is said to have poor form. As examples, failure to close the loop of the "a", "d", or "o", "m" and "n" which are not rounded at the top of the strokes, failure to complete the loop of "b", "g", "h", "j", "l", and "y", in-

TABLE I

LETTER FORMATION IN SELECTIONS 2 TO 11*

Selection	Number of Letters with Good Formation	Number of Letters with Poor Formation	Total Number of Letters	Per Cent of Good Letters	Per Cent of Poor Letters
2	148	7	155	95	5
3	25	127	152	16	84
4	160	4	164	98	2
5	126	5	131	96	4
6	125	7	132	95	5
7	138	7	145	95	5
8	138	9	147	94	6
9	140	5	145	97	3
10	128	6	134	96	4
11	134	4	138	97	3

* Data are not included for Selection 1, since it is printed material.

correct formation of "r", "w", "v", confusion of "i" and "e", or of "a" and "o", or any malformation of a letter—all these indicate the basis on which letters have been judged as having poor formation. Comparison of the data in Table I shows a high degree of uniformity of all paragraphs with respect to letter formation—varying from 94 per cent to 98 per cent except for Selection 3—the paragraph which was written expressly to provide a selection characterized by poor letter formation. Selection 3, with a total of 152 letters, contains 127 letters—84 per cent—that are classified as having poor formation.

Selections 4 to 7 differ from Selection 2 (Normal Writing) with respect to the spacing. Dividers were used to measure the space between each letter and between each word in every selection of handwriting. Table II shows the average spacing between each letter and between each word in Selections 2 to 11.

TABLE II

AVERAGE SPACING BETWEEN WORDS AND BETWEEN LETTERS IN SELECTIONS 2 TO 11 (IN UNITS OF SIXTEENTHS OF AN INCH)

Selection	Average Spacing (in 1/16 inch) Between Words	Between Letters
2	3.4	1.4
3	3.8	1.6
4	3.1	0.7
5	1.2	0.8
6	4.0	1.9
7	5.2	2.9
8	3.1	1.8
9	3.1	1.8
10	3.0	1.5
11	3.5	1.5

Selection 4 was written in the author's normal handwriting, but the spacing was greatly reduced between the letters in each word. However, the spacing was normal between each word. In Selection 5 the spacing was greatly reduced between letters and also between the words of the paragraph. Table II shows that the average spacing between words is 3.1 sixteenths of an inch, and 0.7 sixteenths of an inch between letters for Selection 4, and 1.2 sixteenths between words, and 0.8 sixteenths of an inch between letters for Selection 5, compared to 3.4 and 1.4 between words and letters, respectively, for Selection 2 (Normal Handwriting).

Selection 6 was written in normal handwriting, but the space between lines was reduced to ¼ inch, to discover whether this reduction would affect the legibility of the selection. The spacing between letters and between words for Selection 6 is 4.0 sixteenths and 1.9 sixteenths, respectively.

In Selection 7 the spacing was increased between words and between letters, and the average space between words and between letters is 5.2 sixteenths and 2.9 sixteenths, respectively—the greatest average spacing for the entire group of selections.

Selection 8 was written in such a manner that a large number of the letters would have uneven alinement. A letter is considered to be imperfectly alined if it does not extend to the horizontal line of writing (except letters like "g", "j", and "y", parts of which normally extend below the line). Guide lines, drawn on thin paper, were placed over the selections of writing in order to discover which letters were imperfectly alined. Table III shows data for alinement for Selections 2

TABLE III

ALINEMENT OF LETTERS IN SELECTIONS 2 TO 11

Selection	Number of Letters				Percentage		
	Above Line	Below Line	On Line	Total	Above Line	Below Line	On Line
2	10	0	167	177	6	0.	94
3	13	1	138	152	8	.6	91
4	5	1	158	164	3	.6	96
5	5	0	126	131	4	0.	96
6	10	0	123	133	8	0.	92
7	9	3	133	145	6	2.	92
8	24	57	66	147	16	39.	45
9	17	2	126	145	12	1.	87
10	9	0	125	134	7	0.	93
11	7	0	131	138	5	0.	95

to 11. This table shows that the amount of properly alined letters varies from 87 per cent for Selection 9, to 96 per cent for Selections 4 and 5, except for Selection 8 (poor alinement) in which only 45 per cent of the letters show proper alinement, with 16 per cent of the letters written above the line, and 39 per cent below the line.

Selection 9 was written in the author's usual style except that the slant was varied. A protractor was used to measure the angle of slant (with the base line of writing) of all the letters in Selections 2 to 11. There is no standard slant that is considered "correct" for handwriting, but experts are in agreement that the slant should not exceed 30 degrees from vertical with the base line.[6] Regularity of slant is considered more important in writing than is the degree of slant. Table IV presents data for each selection of handwriting in this study, and shows the amount of variation of slant for the letters in Selection 9, compared with all other selections.

Selection 10 was written with the heaviest writing pen available — Esterbrook #788. Writing was done with heavier lettering pens, but the ink did not spread uniformly on the paper, and unsatisfactory records resulted, except when the size of the writing was appreciably increased.

Selection 11 was written with the finest writing pen available—Spencerian #1. Fine lettering pens were tried, but the records produced by their use showed great variation in the width of the line, and the use of pens finer than Spencerian #1 changed markedly the quality of the handwriting.

In Freeman's studies of handwriting he uses "quality of line" to refer to "evenness in the thickness of the line and to smoothness as distinguished from waviness."[7] In the present study "quality of line" will be used in a more restricted sense, and Selections 10 and 11 are studied to determine how the use of a light or heavy line in writing affects the legibility of the writing, compared to the use of a line of medium weight.

APPARATUS AND TECHNIQUE

Legibility might be measured by the distance at which it is necessary to place the material so that it may be read at a stated rate with given accuracy. Degree of legibility may be measured also by the rate and accuracy with which the material can be read at a given distance. The latter method was chosen for this study. The subjects were asked to read paragraphs of handwriting, and a photographic record of eye-movements was made by means of a camera equipped with 35 mm. motion picture film.

The technique of recording eye-movements by means of photographs is sufficiently familiar not to require extended description here. The reader is referred to a detailed account of the technique presented by C. T. Gray in his monograph.[8] The subjects read under favorable conditions, unaffected by distracting influences. Before reading, the camera and the equipment were explained to those subjects for whom the laboratory was unfamiliar. A large number of the subjects were students in the Department of Education to whom the eye-movement apparatus was already familiar. The subject and the

[6] Frank N. Freeman, *The Teaching of Handwriting* (Boston: Houghton Mifflin Company, 1915), p. 99.

[7] Frank N. Freeman and Mary L. Dougherty, *How To Teach Handwriting* (Boston: Houghton Mifflin Company, 1923), p. 170.

[8] C. T. Gray, *Types of Reading Ability as Exhibited Through Tests and Laboratory Experiments*, Supplementary Educational Monographs, Vol. I, No. 5 (Chicago: University of Chicago Press, 1917), pp. 83–90.

TABLE IV

ANGLE OF SLANT OF LETTERS (WITH BASE LINE OF WRITING) FOR SELECTIONS 2 TO 11

Angle (in degrees)	Frequency for Each Selection									
	2	3	4	5	6	7	8	9	10	11
114								1		
107								1		
105								2		
103								3		
102								1		
101								1		
100								3		
97								1		
96								1		
95							1	3		
94								1		
93		1						2		
92		2						6		
91		1						7		
90	1	3	1	1	1	2		15		2
89	2					1		5		
88	1	1	1		2		3	6		
87	3	8	5	1	8	7	7	13	2	1
86	1	6	4	2	4	5	7	3		1
85	27	2	8	3	14	9	20	8		12
84	2		3	2	5	8	4	3	2	16
83	12	14	11	13	23	14	37	1	18	6
82	7	16	16	13	22	14	16	2	14	5
81	9	5	10	13	10	4	1		8	32
80	21	25	30	30	17	19	22	3	27	12
79	17	17	12	6	7	10	1	2	2	30
78	21	15	19	14	9	16	20	10	28	6
77	1	13	12	18	8	8	1	5	2	
76	8	2	10	5	2	13		6	5	8
75	17	7	10	5	1	7	3	3	11	5
74			4	2		4		5	6	2
73	2	12	5	2		2	1	6	1	
72		2	1	1		2	3	2	3	
71	1							4	1	
70			1					1	4	
69								1		
68			1							
67								1		
66								3		
65										
64										
63								2		
55								1		
54								1		
Total	12292	12198	13059	10442	10897	11652	12060	12200	10577	11024
No. of Letters	153	152	164	131	133	145	147	145	134	138
Mean	80.3	80.2	79.6	79.7	81.9	80.3	82.0	84.1	78.9	79.9

experimenter were alone in the room during the reading, and there were no disturbing factors to modify the performance of any subject.

The subjects were asked to read through the paragraph once, silently, in their accustomed manner of reading any material that they wished to remember. They were told that at the end of the reading of each paragraph simple questions would be asked to test how well the reading had been done. The questions were not standardized, but were designed only as an incentive for the subjects to read the selections with care. No comment was made, either favorable or unfavorable, on the answers that the subjects gave to questions, since the experimenter did not wish to influence the performance of the subjects by introducing any factors extraneous to the reading of the material.

Before beginning the reading of each paragraph the subject was asked to "close your eyes as soon as you have finished the last line." The precaution precluded the possibil-

ity of additional eye-movements back over the material which had already been read.

The developed films were placed in a projector, and the enlarged image of the eye-movements was adjusted exactly to fit the length of the line of handwriting of each selection. The eye-movements for each subject for each selection were plotted. In this manner an exact record was obtained for each subject of the number, location, and duration of every eye pause during the reading of each paragraph.

Subjects

Adults were selected as subjects for this study, on the assumption that the reading of handwriting is more largely an activity of adults than of children. The subjects were selected at random, on the basis of availability. Many were University students, both undergraduates and graduates. Some records were discarded owing to the fact that the subjects wore glasses habitually, and the necessity of reading without glasses before the camera modified the reading to so large an extent that the eye-movement record obtained did not show typical reactions for the subject. The records of 35 subjects were used —11 women and 24 men. Twenty subjects read the entire series of eleven selections. Selection 3 (poor letter formation) and Selection 7 (wide spacing between letters and between words) consistently produced a marked change in the character of reading for all subjects. Hence, these selections were omitted from the reading performance of the remaining fifteen subjects for this study.

The Reading of Printed Material

The paragraph of printed material (Selection 1) was used in order to get a measure of the reading ability of the subjects. The lines of print in this paragraph are shorter than the lines of handwriting used in the other paragraphs used in this study. In the process of reading printed material the eye covers less distance in the line, but encounters more words per line than in the handwriting selections. The printed characters have more uniformity than those in handwriting. The reaction which readers make to printed material is known; hence, we may discover, through examination of the records of the subjects for the printed material whether the subjects are effective or ineffective readers. We can then compare the performance of these subjects as they read paragraphs of handwriting. Apparent differences between a subject's reading records for the printed material and the handwriting selections may be accounted for by the variation between the printed and the written paragraphs. It can be determined at what point the reader may be experiencing difficulty if a study of eye-movements is made as he proceeds from paragraph to paragraph. Since the difficulty of the content of the paragraphs of handwriting is constant, any variation in the reading records for any subject from paragraph to paragraph can be assigned to factors in the handwriting itself, rather than to the difficulty of the content of the paragraphs.

In the plates presented in this study the vertical lines show the location of fixations of the eye during the reading. While the eye is at rest the reader perceives material both to the right and left of the fixated position. A large number of vertical lines indicates numerous pauses, and a small number indicates few pauses during the reading. The wider the eye-span the fewer the pauses (or fixations) per line; vice versa, the narrower the eye-span the greater the number of pauses, in order that the reader may perceive the material. The numbers above the vertical lines indicate the order in which the pauses were made within the line. The numbers below the vertical lines show the duration of the pauses, measured in units of twenty-fifths of a second.

The difference between effective and ineffective reading can be determined by a study of the eye-movement records. Effective reading has relatively few fixations per line. Five to six should be sufficient for a line of print such as is found in Selection 1. If the subject has mature reading habits, these fixations should be more or less regularly spaced within the lines, because mature reading is characterized by rhythmical movements of the eyes along the line of print. The immature reader, on the other hand, fixates frequently, and the distance between the fixations within the line is likely to show irregularity. Frequent fixations in the line indicate that it is necessary for the reader to break up the line of print into small units in order to comprehend the material. The necessity for small units may be accounted for by the form of the material, or may be occasioned by the

difficulty of the content. The presence of a large number of fixations is evidence, therefore, that the reader is encountering difficulty, either on account of the form, or because the content is difficult to comprehend. The subject who has developed mature reading habits shows little variation in the duration of the pauses. The fixations are not altogether uniform, but the variation in the duration of the fixations is not marked. If a reader encounters anything unusual in the reading process he may involuntarily increase the duration of the fixations in order more deliberately to perceive the material. In effective reading of ordinary easy material such as Selection 1 pauses of unusual length should be infrequent.

Another characteristic of effective reading is the regularity of eye-movement from left to right. If the subject has developed good reading habits the eye moves along the line from the beginning to the end in a series of short movements, followed by a long return sweep of the eye to the left to the beginning of the next line. An occasional regressive movement back toward the left is not unusual even in effective reading, especially near the beginning of lines. These regressive movements at the beginning of lines are caused by a failure to make a long enough return sweep to carry the eye the entire distance back from the end of one line to the beginning of the following line. As the subject reads, if he encounters difficulty so that his rhythm is disturbed, he is also likely to make regressive movements in order more effectively to recognize what is printed in the line. The control of the eye, in an attempt to hold it in one position for any great length of time, is difficult, and for this reason, when a subject pauses for a considerable period of time at any point in the reading, the record is likely to show not one long fixation, but rather a series of separate movements, shifting irregularly backward and forward along the line. The subject who has failed to develop good reading habits will manifest this shifting tendency of the eye to a much more marked degree than will the subject who has developed good habits. A large number of regressive movements means that the reader is encountering difficulty in his reading.

These characteristics of eye-movements in reading will be more apparent if a comparison is made between the records of the most effective and of the least effective readers among the subjects used in this study. The record of an effective reader shows a relatively large average number of words per fixation, the duration of the fixations is short, and the average number of words per regressive movement is large. Ineffective readers have a relatively small number of words per fixation, the duration of the fixations is likely to show considerable variation, and the reading records are likely to show a smaller number of words per regression than in the records of effective readers.

Table V presents data for Selection 1 (Printed Paragraph) for all subjects with reference to the average number of words read per fixation, the average duration of fixations, and the average number of words read per regression.

The average number of words read per fixation for all subjects is 1.4, ranging from 0.9 for Subject 19 to 2.0 for Subject 6. The average duration of fixations in units of 1/25 second is 6.5, with a range from 4.5 for Subject 32 to 8.6 for Subjects 1 and 5. The average number of words read per regression is 19.4, with a range from 5.7 for Subject 19 to 40+ for the six subjects whose records contain no regressive movements. It is apparent that the variation from subject to subject is not consistent for the number of words read per fixation, the average duration of fixations, and the average number of words per regression. Some subjects who are effective readers may have a high average number of words per fixation, but use relatively long fixation time. Most of the subjects had few regressive movements. Subject 19, with seven regressive movements, had the largest number of the entire group.

The variation in the reading records for the entire group will be more apparent if the records of the eight most effective readers are compared with the records of the eight least effective readers.

In selecting the eight most effective readers and the eight least effective readers of the subjects used in this study the following method was used. The reading record for Selection 1—the printed paragraph—for each subject was assigned a rank order, according to each of these criteria: (1) average number of words read per fixation, with highest rank to subjects having the largest number, (2) the duration of fixations, with the highest rank to subjects having the shortest duration,

TABLE V

NUMBER OF FIXATIONS, AVERAGE NUMBER OF WORDS READ PER FIXATION, AVERAGE DURATION OF FIXATIONS, AND THE AVERAGE NUMBER OF WORDS READ PER REGRESSION FOR SELECTION 1

Subject Number	Number of Fixations	Average Number of Words Read per Fixation	Average Duration of Fixations	Average Number of Words per Regression*
1	21	1.9	8.6	10.0
2	33	1.2	5.5	40.00
3	29	1.4	7.7	8.0
4	27	1.5	6.0	40.0+
5	26	1.5	8.6	40.0
6	20	2.0	5.5	40.0
7	22	1.8	7.8	40.0
8	26	1.5	6.1	40.0
9	31	1.3	5.0	20.0
10	23	1.7	6.9	40.0+
11	24	1.7	6.5	40.0
12	31	1.3	5.9	40.0
13	36	1.1	6.1	8.0
14	21	1.9	8.5	20.0
15	26	1.5	6.5	40.0
16	32	1.2	7.0	13.3
17	32	1.2	7.3	40.0
18	32	1.2	7.0	10.0
19	44	0.9	6.8	5.7
20	37	1.0	7.0	10.0
21	24	1.7	4.9	20.0
22	28	1.4	7.1	20.0
23	36	1.1	8.2	13.3
24	30	1.3	5.8	40.0+
25	24	1.7	6.0	40.0+
26	14	2.8	7.2	40.0+
27	28	1.4	6.8	40.0
28	27	1.5	5.5	40.0
29	33	1.2	5.5	40.0
30	34	1.2	6.0	40.0
31	34	1.2	7.4	10.0
32	29	1.4	4.5	40.0
33	34	1.2	5.1	20.0
34	26	1.5	5.4	40.0+
35	31	1.3	6.5	8.0
Total	1005	----	----	----
Mean	28.7	1.4	6.5	19.4

* The records followed by plus signs in the last column are records of subjects who made no regressions in the entire selection. The plus sign indicates that the records might have been higher with a longer selection.

(3) average number of words per regressive movement, with highest rank indicating the largest number of words read per regression. The average of these three rankings was used as an index of the relative rank of each subject in the effectiveness of his reading.

On this basis Subjects 4, 6, 10, 21, 25, 26, 32 and 34 may be regarded as the eight most effective readers of the entire group, and the eight least effective readers are Subjects 3, 13, 16, 18, 19, 20, and 23.

Table VI presents data for the eight most effective readers and for the eight least effective readers in the group of subjects.

It is evident that the most effective readers are superior to the group of least effective readers in every characteristic. The most effective group shows a mean of 23.8 fixations for the paragraph, compared with 35.0 for the least effective group. In comparing the average number of words per fixation the most effective readers show a mean of 1.8 compared with 1.1 for the least effective readers. In average duration of fixations the most effective readers have a mean of 5.8 twenty-fifths of a second, compared with 7.1 for the least effective readers. A large difference exists between the two groups with respect to the average number of words per

TABLE VI

AVERAGE NUMBER OF WORDS READ PER FIXATION, AVERAGE DURATION OF FIXATIONS, AVERAGE NUMBER OF WORDS READ PER REGRESSION FOR THE MOST EFFECTIVE AND FOR THE LEAST EFFECTIVE READERS, FOR SELECTION 1

Subject Number	Number of Fixations	Average Number of Words Read per Fixation	Average Duration of Fixations	Average Number of Words Read per Regression
Most Effective Readers				
4	27	1.5	6.0	40.0+
6	20	2.0	5.5	40.0
10	23	1.7	6.9	40.0+
21	28	1.7	4.9	20.0
25	24	1.7	6.0	40.0+
26	14	2.8	7.2	40.0+
32	29	1.4	4.5	40.0
34	26	1.5	5.4	40.0+
Total	191	14.3	46.4	300.0
Mean	23.8	1.8	5.8	37.5
Least Effective Readers				
3	29	1.4	7.7	8.0
13	36	1.1	6.1	8.0
16	32	1.2	7.0	13.3
18	32	1.2	7.0	10.0
19	44	0.9	6.8	5.7
20	37	1.0	7.0	10.0
23	36	1.1	8.2	13.3
31	34	1.2	7.4	10.0
Total	280	9.1	57.2	78.3
Mean	35.0	1.1	7.1	9.8

regression, with 37.5 as the mean for the most effective readers and 9.8 for the least effective readers.

The most effective readers use fewer fixations in reading the paragraph, with a larger average number of words per fixation. They employ shorter fixation time than is found in the records of the least effective readers. They also use few regressive movements. The least effective readers invariably make regressive movements in reading Selection 1.

THE READING OF NORMAL HANDWRITING

Selection 2 may be regarded as the normal selection of handwriting for this study, since it has good letter formation, regular spacing, even alinement, uniform slant, and a medium weight of line. It will be considered as the standard for comparison with other paragraphs of written material used in the study. It has been pointed out that printed material exhibits regularity of spacing within the line.[9] Handwriting, on the other hand, shows variation within the selection. Because it is handwriting there will necessarily be some modification in spacing (between letters and between words), letter formation will show some imperfections, the slant will lack perfect uniformity, and the variations in pressure during the writing process will result in modification in the weight of line. The eye of the reader must, of necessity, be accommodated simultaneously to these variations during the process of reading the handwriting. For this reason it is to be expected that the reading records for normal handwriting will be to some extent dissimilar to the records for the printed material.

In effective reading of printed material the eyes move from left to right along the lines, in a series of regular, rhythmic pauses. For simple material the pauses are infrequent, the duration of the fixations is short, there is considerable uniformity of distance between the fixations, and few regressive movements are present. These general characteristics of the reading of printed material show some degree of modification when the subjects read a selection of handwriting. A comparison of the reading records for Selection 1 and Selection 2 will show the extent of this modification.

Table VII shows data for all the subjects who read the paragraph of normal handwriting (Selection 2).

[9] Cf. *supra*, p. 14.

TABLE VII

NUMBER OF FIXATIONS, AVERAGE NUMBER OF WORDS READ PER FIXATION, AVERAGE DURATION OF FIXATIONS, AND AVERAGE NUMBER OF WORDS READ PER REGRESSION FOR SELECTION 2

Subject Number	Number of Fixations	Average Number of Words Read per Fixation	Average Duration of Fixations	Average Number of Words per Regression
1	41	0.9	6.3	4.7
2	--	---	---	----
3	36	1.0	7.7	7.6
4	37	1.0	5.7	38.0
5	40	0.9	6.6	12.7
6	29	1.3	6.0	38.0
7	28	1.3	6.6	38.0
8	31	1.2	5.0	38.0
9	39	0.9	5.5	19.0
10	32	1.2	7.6	38.0
11	40	0.9	5.7	9.5
12	33	1.1	6.7	19.0
13	51	0.7	6.4	3.8
14	32	1.2	7.0	19.0
15	36	1.0	6.0	7.6
16	32	1.2	5.4	19.0
17	49	0.8	6.0	7.6
18	45	0.8	6.5	5.4
19	46	0.8	6.3	3.1
20	46	0.8	6.9	9.5
21	35	1.1	4.9	38.0
22	--	---	---	----
23	44	0.8	7.5	5.4
24	35	1.1	6.3	19.0
25	23*	1.2	5.1	28.0
26	34	1.1	5.3	19.0
27	38	1.0	6.4	12.7
28	38	1.0	5.3	6.3
29	41	0.9	5.4	12.7
30	40	0.9	5.5	12.7
31	36	1.0	6.0	12.7
32	35	1.8	4.1	38.0+
33	38	1.0	5.6	7.6
34	40	0.9	4.7	5.4
35	41	0.9	5.8	7.6
Total	1241	----	----	----
Mean	37.6	1.0	6.0	10.1

* Record is for five lines.

The first difference to be noted in the reading of the two selections is that handwriting requires more eye-movements than printed material. The eye-span is narrowed in reading the paragraph of handwriting, necessitating more pauses as the subject progresses along the lines. For the entire group of subjects in reading printed material the average number of words per fixation is 1.4. In reading handwriting the average number of words per fixation for the group drops to 1.0. The difference is large enough to indicate that the handwriting presents greater difficulty to the reader than does the printed selection. This difference is consistent when the individual subjects are considered. Every subject, with the exception of Subjects 16 and 32, shows a smaller number of words read per fixation in Selection 2 than in Selection 1. Subject 16 shows an average of 1.2 words per fixation for both selections, and Subject 32 shows an average of 1.4 words for print and 1.8 for handwriting. Subject 32 is the one subject in the group whose record for reading handwriting shows a larger average number of words per fixation for handwriting.

A second criterion by which to judge the difficulty of material is the duration of the fixations of the eye. Long durations indicate a deliberate reaction to the characters in the material being read. Table VII shows an average duration of 6.0 twenty-fifths second for the fixations for all subjects in reading handwriting, compared with the average dura-

tion of fixations of 6.5 twenty-fifths second for all subjects in reading Selection 1 (printed paragraph). In reading handwriting the subjects employ shorter pauses than in reading printed material. Instead of increasing the duration of fixations in reading handwriting the subjects use fixations of shorter duration, but they increase the number of fixations.

A third difference between the reading of handwriting and printed material is to be noted in the number of regressive movements in the records. As material increases in difficulty the subject tends to retrace the material already read in order to increase his perception. Hence, the presence of regressive movements in a reading record is indicative of difficulty, or at least of uncertainty on the part of the reader. Absence of regressive movements in a reading record is an indication that the reader finds the material easy to comprehend, without the necessity for additional backward movements in the line. Table VII shows an average of 10.1 words per regressive movement for the entire group of subjects, compared with an average of 19.4 words per regressive movement for the printed paragraph. It is evident that the reading of handwriting is more difficult than printed material, since the average number of words per regression shows such a marked decrease below the average for the printed material—47.9 per cent.

Not only is the average number of words read per regression less for handwriting than for printed material, but the differences are consistent when the records for the two selections are compared. The records for all subjects show a smaller number of words read per regression except Subjects 21 and 31. These two subjects show a larger average number of words read per regression for the handwriting than for the printed material. It is evident that the reading of handwriting causes more regressive movements than does printed material.

These differences in the averages for the entire group between the records for the paragraph of print and the paragraph of handwriting are borne out in an examination of the records of the most effective readers, and their comparison with the records of the least effective readers. The records of both groups show a superior performance for the reading of the selection of printed material.

Table VIII shows data for the eight most effective readers and the eight least effective readers in the entire group of subjects.

TABLE VIII

AVERAGE NUMBER OF WORDS READ PER FIXATION, AVERAGE DURATION OF FIXATIONS, AVERAGE NUMBER OF WORDS READ PER REGRESSION FOR THE MOST EFFECTIVE AND FOR THE LEAST EFFECTIVE READERS, FOR SELECTION 2

Subject Number	Number of Fixations	Average Number of Words Read per Fixation	Average Duration of Fixations	Average Number of Words Read per Regression
Most Effective Readers				
4	37	1.0	5.7	38.0
6	29	1.3	6.0	38.0
10	32	1.2	7.6	38.0
21	35	1.1	4.9	38.0
25	23	1.2	5.1	28.0
26	34	1.1	5.3	19.0
32	35	1.8	4.1	38.0+
34	40	0.9	4.7	5.4
Total	265	9.6	43.4	242.4
Mean	33.1	1.2	5.4	30.3
Least Effective Readers				
3	36	1.0	7.7	7.6
13	51	0.7	6.4	3.8
16	32	1.2	5.4	19.0
18	45	0.8	6.5	5.4
19	46	0.8	6.3	3.9
20	46	0.8	6.9	9.5
23	44	0.8	7.5	5.4
30	40	0.9	5.5	12.7
Total	340	7.0	52.2	67.3
Mean	42.5	0.8	6.5	8.4

Table VIII shows a mean of 1.2 words per fixation for the most effective readers for Selection 2, compared with 1.8 words for Selection 1. The number of words read per fixation is less for the most effective readers for handwriting than for the printed paragraph. Table VIII shows that for the less effective readers there is an average of 0.8 words per fixation, compared with 1.1 words per fixation for the printed selection. For both groups of subjects the selection of handwriting was more difficult, judged by the number of words read per fixation.

An examination of the data for the average duration shows a consistent use of shorter fixations in reading handwriting than in reading the printed selection. The eight most effective readers show an average duration of 5.4 twenty-fifths second per fixation in reading handwriting, compared with 5.8 for the printed selection. The eight least effective subjects have an average duration of 6.5 twenty-fifths second per fixation for handwriting, compared with 7.1 for the printed paragraph. Both groups are consistent in the use of shorter fixations in reading handwriting.

Both the most effective and the least effective readers show a smaller average number of words read per regression for handwriting than for printed material. Table VIII shows an average of 30.3 words per regression for the most effective readers, compared with 37.5 for the same group for printed material. The least effective readers have an average of 8.4 words per regression for handwriting, compared with 9.8 words per regression for the printed paragraph. It is evident that for both the most effective and the least effective readers there is a decided increase in the number of regressive movements employed in reading handwriting, compared with the reading of printed material.

Poor Letter Formation and Legibility

Previously the reading of normal handwriting was compared with the reading of printed material. The reading records show that there is a significant difference between the difficulty of the reading of printed material and of handwriting, judged by the criteria of the average number of words read per fixation, average duration of fixations, and average number of words read per regression. The general character of the reading process is the same for printed material and for handwriting, but there is a consistent decrease in the average number of words read per fixation, and in the average number of words read per regression for handwriting, compared with printed material. Subjects use a shorter average duration of fixations in reading handwriting than in reading printed material.

In order to determine the effect of poor letter formation on legibility it is necessary to employ a selection of handwriting that is comparable to normal handwriting in every respect, except that the letter formation shall be poor. Selection 3 is the paragraph with all the characteristics of good handwriting except good letter formation. Eighty-four per cent of the letters in Selection 3 are poorly formed.[10] Any differences observed in the reading records for this paragraph, compared with the paragraph of normal handwriting (Selection 2), are to be accounted for on the basis of the quality of letter formation employed in the two selections.

In the conduct of the investigation the subjects showed such a high degree of consistency of performance in reading this paragraph (with poor letter formation) that no subjects beyond Subject 20 read this selection. Table IX shows data for the twenty subjects who read this selection.

For Selection 3 the average number of words read per fixation is 0.8, the average duration of the fixations is 6.4 twenty-fifths second, and the average number of words read per regression is 4.3.

Since only twenty subjects read Selection 3 it will be necessary, in comparing the records of readers for Selection 2 and Selection 3, to include the records of only the first twenty subjects in Table VII. For Subjects 1 to 20 for Selection 2 (Table VII) the average number of words read per fixation is 1.0, the average duration of fixations is 6.3 twenty-fifths second, and the average number of words read per regression is 17.7.

Poor letter formation reduces the average number of words read per fixation from 1.0 for normal handwriting to 0.8, for all subjects. The subjects use a narrower eye-span in reading the material with poor letter formation. Three subjects show no change in eye-span for the selection with poor letter formation, since the average number of words read per fixation is the same for both Selection 2 and Selection 3. All other subjects

[10] Cf. *supra*, p. 7.

show a consistently smaller number of words per fixation for handwriting with poor letter formation. The decrease varies from 0.1 to 0.3 words per fixation for each subject. No subject shows a larger average number of words per fixation for the selection with poor letter formation.

The average duration of fixations for the selection with poor letter formation varies only slightly from the average duration of fixations for the selection of normal handwriting, with 6.3 twenty-fifths and 6.4 twenty-fifths, respectively, for the two selections. Four subjects use fixations of the same durations for both selections, nine subjects use longer fixations, and the other subjects use fixations of shorter average duration in reading the selection with poor letter formation. The subjects do not show any consistent trend in the duration of their fixations. The reading of handwriting with poor letter formation does not equally affect the fixation time for all subjects, when compared with the fixation time for normal handwriting.

In comparing Selection 2 with Selection 3 with respect to regressive movements it is clear that poor letter formation increases the number of regressions. The average number of words read per regressive movement for twenty subjects for Selection 3 is 4.3, compared with 17.7 for the same subjects for Selection 2. Not only is the average number of words decreased for the selection with poor letter formation, but there is also a consistent decrease when the records of individual subjects are considered. Every subject shows a smaller average number of words per regression for the selection with poor letter formation, when compared with normal handwriting. Poor letter formation increases the number of regressive movements for every subject.

Spacing and Legibility

In order to study the effect of spacing on the legibility of handwriting, four selections were read by the subjects: (1) Selection 4, in which the spacing was reduced between the letters, and also between the words; (2) Selection 5, in which the spacing was reduced between the letters, but normal spacing was kept between the words; (3) Selection 6, in which normal spacing was kept between letters and words, but narrower spacing (one-fourth inch) was used between the lines of handwriting; (4) Selection 7, in which the spacing was increased between letters and between words. Each selection will be considered, in turn, in order to discover the effect

Table IX

Number of Fixations, Average Number of Words Read Per Fixation, Average Duration of Fixations, and Average Number of Words Read Per Regression for Selection 3

Subject Number	Number of Fixations	Average Number of Words Read per Fixation	Average Duration of Fixations	Average Number of Words per Regression
1	53	0.8	7.0	2.7
2*	40	0.9	5.5	18.5
3	54	0.8	7.0	2.8
4	45	0.9	5.9	6.1
5	52	0.8	6.2	2.8
6	41	1.0	7.6	5.4
7	38	1.1	7.2	10.8
8	38	1.1	5.0	21.5
9	44	0.9	6.5	5.4
10	45	0.9	6.8	6.1
11	66	0.6	6.0	4.3
12	44	0.9	5.8	14.3
13	67	0.6	5.8	2.1
14	44	0.9	7.0	6.1
15	53	0.8	5.7	2.8
16	41	1.0	5.9	8.6
17	51	0.8	6.0	4.3
18	56	0.8	6.5	3.0
19	75	0.6	6.4	1.9
20	62	0.7	7.1	4.3
Total	1009	---	---	----
Mean	50.4	0.8	6.4	4.3

* Record is for six lines.

of each spacing on the ease with which subjects can read the handwriting.

How is the legibility of handwriting affected, if the spacing is altered? Comparison of the selection of normal handwriting with other selections in which only the spacing has been modified, shows these results.

1. When spacing is reduced between letters and between words: The reduction of spacing shortens the line of handwriting and permits the subject to read a significantly larger average number of words per fixation than in normal handwriting. The average duration of fixations does not show any significant change when the spacing is reduced. The average number of words read per regression shows some reduction in reading the shortened line, but the difference is not significant. The reduction of spacing does make handwriting more legible, by increasing the number of words per fixation.

2. When spacing is reduced between letters, but normal spacing is maintained between words: The reduction in spacing increases significantly the average number of words read per fixation. The duration of fixations does not show any significant change. The average number of words per regression does not show any significant change. Decreasing the spacing results in improvement in legibility over normal handwriting, by increasing the average number of words per fixation.

3. When spacing is reduced to ¼" between the lines of handwriting: There is no significant change in legibility. The ease with which the handwriting can be read is not conditioned by the spacing between lines. Handwriting with ¼" spacing between the lines is as easily read as the handwriting with ⅝" spacing. The average number of words read per fixation, the duration of fixations, and the average number of words read per regression show that subjects read one selection as well as the other, when normal handwriting with the two spacings is compared.

4. When spacing is increased between the letters and between the words: There is a significant decrease in the average number of words read per fixation, and in the average number of words read per regression. It is clear that the legibility of handwriting decreases when the spacing between letters and between words is increased.

Compactness in the line of handwriting increases legibility of handwriting, but lack of compactness in handwriting decreases legibility.

Slant and Legibility

Selection 9, written with irregular slant of letters is comparable to Selection 2 in all respects except the slant. Table IV shows variation in the amount of slant for Selection 9 compared with all other selections used in this study.[11] The slant of the letters in Selection 2 varies from 71 to 90 degrees with the base line of writing. The slant of the letters in Selection 9 varies from 54 to 114 degrees with the base line of writing.

The data for the subjects will be analyzed to discover what effect the irregularity of slant has on the legibility of the handwriting.

Table X presents the data for the reading records of the thirty-five subjects who read Selection 9.

Table X shows for all subjects an average of 1.0 word read per fixation, with a range from 0.8 to 1.4. The average number of words read per fixation is the same as for normal handwriting, but only four subjects have the same average for Selection 9 and for Selection 2. Eighteen subjects have a larger average number of words read per fixation for Selection 9, and eleven have a smaller average for Selection 9. The average number of words read per fixation is not consistently larger for all subjects in reading Selection 9.

The average duration of fixations for all subjects is 5.9 twenty-fifths second for Selection 9, compared with 6.0 for Selection 2, normal handwriting. Not all subjects show consistently a longer average duration of fixations for one selection. Four subjects have the same average duration of fixations for both selections, eleven have a larger average duration of fixations for Selection 9, and the remaining subjects have a longer average duration of fixations for normal handwriting. The slight difference in average duration—0.1 twenty-fifths second—does not indicate any great difference in reading difficulty in the two selections.

The average number of words read per regressive movement for all subjects is 7.8, compared with 10.1 for the selection of normal handwriting. No subjects show the same average number of words per regressive movement for both Selection 9 and Selection 2.

[11] Cf. *supra*, p. 10.

TABLE X

NUMBER OF FIXATIONS, AVERAGE NUMBER OF WORDS READ PER FIXATION, AVERAGE DURATION OF FIXATIONS, AND AVERAGE NUMBER OF WORDS READ PER REGRESSION FOR SELECTION 9

Subject Number	Number of Fixations	Average Number of Words Read per Fixation	Average Duration of Fixations	Average Number of Words per Regression
1	48	0.9	5.8	3.2
2	39	1.1	4.9	14.0
3	39	1.1	6.9	8.4
4	35	1.2	5.1	14.0
5	39	1.1	6.1	7.0
6	34	1.2	7.9	21.0
7	29	1.4	6.6	21.0
8	33	1.3	5.0	42.0
9	37	1.1	6.5	14.0
10	36	1.1	6.4	14.0
11	42	1.0	5.1	8.4
12	45	0.9	5.1	7.0
13	68	0.6	5.7	2.2
14	36	1.1	7.4	8.4
15	31	1.3	5.7	8.4
16	36	1.1	5.7	10.5
17	45	0.9	6.2	8.4
18	47	0.9	7.2	3.5
19	46	0.9	6.2	3.8
20	46	0.9	6.3	7.0
21	33	1.3	4.9	14.0
22	38	1.1	6.4	42.0
23	41	1.0	8.3	8.4
24	39	1.1	5.6	8.4
25	36	1.1	5.4	10.5
26*	22	1.4	6.0	31.0
27	37	1.1	7.6	21.0
28	48	0.9	5.1	2.8
29	49	0.8	5.2	7.0
30	46	0.9	5.3	10.5
31	41	1.0	5.6	14.0
32	39	1.0	4.4	21.0
33	45	0.9	5.2	8.4
34	39	1.0	4.8	8.4
35	40	1.0	5.8	7.0
Total	1404	---	---	---
Mean	40.1	1.0	5.9	7.8

* Record is for five lines.

Eleven subjects show a larger average number of words read per regression for Selection 9, but all other subjects show a larger average for Selection 2. It is clear that the number of regressive movements increases when subjects read handwriting that has irregular slant.

Table XI shows data for the most effective and the least effective readers for Selection 9.

For the most effective readers the average number of words read per fixation is 1.1 compared with the average of 1.0 for the entire group of subjects. The average number of words per fixation for this same group is 1.2 for normal handwriting, indicating that the most effective readers find normal handwriting slightly easier to read than handwriting with uneven slant. The most effective readers show an average duration of 4.6 twenty-fifths second for Selection 9, and 5.4 for Selection 2. The fixation time is shorter for the selection with irregular slant than for normal handwriting. The most effective readers have an average of 30.3 words read per regression for normal handwriting, compared with 15.8 for handwriting with irregular slant. Writing that has irregular slant is more difficult for the effective readers as judged by the average number of words read per regressive movement.

The least effective readers have an average of 0.9 word read per fixation for Selection 9, compared with 0.8 for Selection 2. The average duration of fixations is 6.4 for Selection 9,

TABLE XI

AVERAGE NUMBER OF WORDS READ PER FIXATION, AVERAGE DURATION OF FIXATIONS, AVERAGE NUMBER OF WORDS READ PER REGRESSION, FOR THE MOST EFFECTIVE AND FOR THE LEAST EFFECTIVE READERS FOR SELECTION 9

Subject Number	Number of Fixations	Average Number of Words Read per Fixation	Average Duration of Fixations	Average Number of Words Read per Regression
Most Effective Readers				
4	35	1.2	5.1	14.0
6	34	1.2	7.9	21.0
10	36	1.1	6.4	14.0
21	33	1.3	4.9	14.0
25	36	1.1	5.4	10.5
26	22	1.4	6.0	31.0
32	39	1.0	4.4	14.0
34	39	1.0	4.8	8.4
Total	274	9.3	44.9	126.9
Mean	34.2	1.1	4.6	15.8
Least Effective Readers				
3	39	1.1	6.9	8.4
13	68	0.6	5.7	2.2
16	36	1.1	5.7	10.5
18	47	0.9	7.2	3.5
19	46	0.9	6.2	3.8
20	46	0.9	6.3	7.0
23	41	1.0	8.3	8.4
30	46	0.9	5.3	10.5
Total	359	7.8	51.6	53.9
Mean	44.9	0.9	6.4	6.9

compared with 6.5 for Selection 2. The average number of words read per regressive movement is 6.9 for Selection 9, compared with 8.4 for Selection 2. The least effective readers show little difference in the records for normal handwriting and the selection with irregular slant. Irregular slant apparently does not alter the reading procedures of ineffective readers to any noticeable degree.

SUMMARY

The foregoing study of reading records for the different selections of handwriting may be briefly summarized.

1. Handwriting is less legible than printed material. In printed material the spacing between words is regular, and the length of lines can be regulated to make one line as long as every other line. The height and form of a letter in a certain style of print is always uniform, no matter how often the letter occurs on the page, or in what combination with other letters. In handwriting the spacing between letters varies to some degree, and the length of all lines is not exactly the same. The height of letters varies even in one word where the same letter may be repeated. The form of letters varies to some extent also. These factors do not vary separately in normal handwriting, but when one factor varies it is quite likely that other factors will also show some degree of variation. For that reason the legibility of letters is not always uniform throughout any selection of handwriting. Therefore the average performance must be used in a consideration of handwriting. Analysis of the data for the selection of print and the selection of normal handwriting show that handwriting is less legible than print. The relationship is consistent, measured by the average number of words per fixation, the average duration of fixations, and the average number of words read per regressive movement.

Table XII shows for all subjects the average number of words read per fixation, the average duration of fixations, and the average number of words read per regression for each selection used in this study.

2. Good letter formation is the most important factor in determining the legibility of handwriting. Conversely, poor letter formation reduces legibility more than any other single factor considered in this investigation.

TABLE XII

AVERAGE NUMBER OF WORDS READ PER FIXATION, AVERAGE DURATION OF FIXATIONS, AND AVERAGE NUMBER OF WORDS READ PER REGRESSION FOR SELECTIONS 1 TO 11

Selection	Average Number of Words Read per Fixation	Average Duration of Fixations	Average Number of Words Read per Regression
1	1.4	6.5	19.4
2	1.0	6.0	10.1
3	0.8	6.4	4.3
4	1.1	6.0	9.2
5	1.0	6.1	9.7
6	1.0	5.8	8.0
7	0.8	6.2	4.4
8	1.1	5.9	11.4
9	1.0	5.9	7.8
10	1.0	5.8	8.6
11	1.1	6.0	8.8

When handwriting has poor letter formation the reader must pause frequently in the line, because the words are not recognized in large wholes. Words are perceived when the eye is at rest, and the eye pauses in the line in order that perception may take place. At each pause the reader perceives groups of letters. If the letters are poorly formed he recognizes them less easily, consequently the units of recognition become smaller, and the number of fixations per line increases. Table XII shows clearly the effect of poor letter formation, with 0.8 word read per fixation for Selection 3, characterized by poor letter formation.

Other evidence of the reduction of legibility when poor letter formation is found in handwriting is furnished by the duration of the fixations. The duration of the fixations is an index to the speed with which the reader recognizes words. If the reader has rapid recognition the pauses are short in duration. In reading the selection with poor letter formation the duration of fixations is longest for all handwriting selections used in this study. The subjects recognize the words least rapidly in this selection.

If material is legible the reader can recognize the written words in the lines with few fixations, and the movement of the eye is from left to right, without the necessity of backward movement. When the handwriting has poorly formed letters the number of words recognized per regression decreases. Table XII shows that Selection 3 has the smallest average number of words read per regression. The data in Table XII show clearly that poor letter formation reduces legibility of handwriting.

Selection 2, normal handwriting, was compared with all other selections used, by means of Fisher's t-test. A summary of all comparisons is given in Table XIII, with reference to the average number of words per fixation, average duration of fixations, and average number of words per regression.

There is greater difference between the selections in the number of words per fixation

TABLE XIII

COMPARISON OF SELECTION 2, NORMAL HANDWRITING, WITH ALL OTHER SELECTIONS, FOR t-TEST

Selections Compared	Average Number of Words per Fixation		Average Duration of Fixations		Average Number of Words per Regression	
	t	P	t	P	t	P
2 minus 1	—8.40	<.01	—3.196	<.01	—4.48	<.01
2 minus 3	5.745	<.01	— .5304	.6<P<.7	6.032	<.01
2 minus 4	—3.5926	<.01	.7923	.5<P<.6	— .3659	.8<P<.9
2 minus 5	—2.430	.01<P<.02	— .546	.6<P<.7	— .3691	.8<P<.9
2 minus 6	.1206	>.9	1.571	.2<P<.3	1.5369	.2<P<.3
2 minus 7	3.8745	<.01	0.00	----------	3.18	<.01
2 minus 8	—2.253	.02<P<.05	1.54	.2<P<.3	—1.5970	.2<P<.3
2 minus 9	— .522	.7<P<.8	.616	.6<P<.7	3.58	<.01
2 minus 10	—1.7024	.05<P<.1	2.548	.01<P<.02	1.9700	.02<P<.05
2 minus 11	—2.7666	<.01	0.00	----------	.0855	>.9

than in the other criteria used. Of the ten comparisons with Selection 2 seven significant ratios occur, one is of questionable significance, and only two are too small to have significance. The variations in handwriting produce significant changes in the number of words read per fixation, compared with normal handwriting. The variations in handwriting do not produce a corresponding change in the average duration of the fixations. Of the ten ratios shown in Table XIII only two are significant. The variations in handwriting result in significant change in the average number of words read per regression. Of the ten ratios five are significant. Variation from normal handwriting did not produce any significant difference, judged by the average number of words read per regression.

3. The compactness of handwriting affects its legibility. Reduction of spacing between letters and between words appears to improve legibility, but the evidence is not conclusive. The reduction of space shortens the line of writing, and results in a decrease in the number of fixations necessary in reading the shortened line. The average number of words read per fixation is increased significantly. The average duration of fixations is decreased, but the decrease is not significant in amount. The average number of words read per regression shows also a slight increase, but not enough to be significant.

Reduction of spacing between letters only, with no reduction between words, shows the same tendency as the reduction of spacing between words and between letters. The average number of words per fixation is increased over the number in normal handwriting, but there is no significant change in the average duration of fixations or in the average number of words read per regression. The reduction of spacing between letters only probably does increase legibility, but the data are not conclusive.

Reduction of spacing from $\frac{5}{8}''$ to $\frac{1}{4}''$ between lines does not noticeably affect the legibility of handwriting. Reference to Table XIII shows that the difference between normal handwriting and handwriting with the narrower spacing (Selection 2 and Selection 6) is too slight to have any significance.

Increasing the spacing between words and between letters reduces legibility. The increase in spacing results in a longer line, which in turn increases the number of fixations. The number of words per fixation is perceptibly and significantly decreased. The average duration of fixations remains exactly the same as for normal handwriting. The average number of words read per regression is significantly decreased. The selection with wide spacing between letters and between words ranks next to the selection with poor letter formation in illegibility.

Compactness in handwriting favors legibility and lack of compactness decreases legibility. The compactness results from decreasing the spacing between the letters and between words: it does not result from a crowding of the letters, or from changing the style of letters in the handwriting. A change in the size or style of letters might show a different result, but this aspect of writing was not investigated in the present study.

4. Evenness of alinement apparently is not an important factor in the legibility of handwriting. Comparison of the results of reading a paragraph with poor alinement and one with good alinement shows that poorly alined handwriting is not less legible than handwriting with good alinement. The poorly alined paragraph shows a significantly larger average number of words read per fixation than does the selection of normal handwriting. When the two paragraphs are compared there is no significant difference in the average duration of fixations, and in the average number of words read per regression. Word recognition is more rapid in the selection of uneven alinement.

5. The regularity of the slant of letters is an important factor in the legibility of handwriting. When the slant of the letters becomes irregular the legibility of handwriting is decreased. Irregular slant does not result in any marked change in the number of words read per fixation. The average duration of fixations is not altered to any significant extent by irregularity of slant, and the records show an average duration of fixations that differs in no significant way from the average duration of fixations from normal handwriting. Handwriting that has irregular slant does show a decrease in the average number of words read per regression. Since regressions occur only as an index of difficulty for the reader, it is evident that irregular slant does decrease the legibility of handwriting. No attempt was made in this study to determine what slant is best, with respect to

legibility, but the data do show that the irregularity of slant does decrease the legibility of handwriting.

6. The results of this investigation are inconclusive, with respect to the influence of weight of line on legibility of handwriting.

A heavy line produces handwriting that is probably more legible than handwriting produced with a medium line. The difference between handwriting produced with a heavy line and handwriting produced with a medium weight of line is doubtful, when judged by the average number of words read per fixation. The number of words is somewhat larger for the selection with the heavier line, but since P lies between .05 and .1, according to Fisher's t-test, the difference cannot be said to be significant. There is a difference in the average duration of fixations for the selection with a heavy line and the selection with medium weight of line, with the longer duration for the heavy line. The average number of words read per regression is larger for normal handwriting than for the handwriting produced with the heavy line. It cannot be definitely stated that a heavy line produces more legible handwriting.

Handwriting that is characterized by a light line is more legible than handwriting that has a medium weight, when judged by the average number of words read per fixation, and the difference is significant. The average duration of fixations for the two selections is exactly the same, showing no difference between the two selections. The average number of words per regression is slightly more for the selection with medium weight, but the difference is very small—not large enough to have any significance. It cannot be stated that the use of a light line in handwriting is an important factor in the legibility of handwriting.

Determination of the effect of weight of line on legibility is not clearly shown in the results of this investigation. Further study is needed to clarify the issue of weight of line and its effect on legibility of handwriting.

Implications

Several implications for the teaching of handwriting grow out of the results of this investigation.

1. No one characteristic of handwriting exists separately from other characteristics, but they are interrelated in the handwriting process. In any attempt to improve the quality of handwriting it is necessary to keep clearly in mind the fact that one characteristic is dependent on others. Letter formation is closely related to spacing, slant, alinement, and weight of line. Any change in one characteristic is accompanied by a corresponding change in the others.

2. Since letter formation is the most important factor in determining the legibility of handwriting, this aspect of writing should receive the greatest emphasis in teaching children to write.

In recent years handwriting instruction has emphasized the use of simplified letter forms, free from flourishes and extra strokes, containing only the essentials of the letters. The results of this study indicate that, from the point of view of legibility, this emphasis is correct.

In teaching children to write, the development of good letter formation should be the chief outcome, and the development of other characteristics should be related to the improvement of letter formation. The chief concern of teachers should be the improvement of other aspects of the handwriting process only as they contribute to good letter formation—not as ends in themselves. Slant, alinement, spacing, and quality of line should receive attention only as they improve letter formation. Principles that result in improvement of letter formation are probably reliable guides to teachers in improving handwriting.

3. Pupils should be taught to use a compact type of handwriting. This should not be developed at the sacrifice of good letter formation, but should emphasize compactness of spacing between letters. A medium or narrow spacing between letters is to be preferred to wide spacing between letters. Since the use of wide spacing in handwriting can develop into a type of writing which results in malformation of letters or in the development of flourishes, pupils should be taught in such a manner that correct letter formation is used even with relatively narrow spacing between letters.

It need not be a matter of concern whether or not children use a particular width of ruling on paper. There is no difference in the legibility of handwriting with $\frac{5}{8}$″ and $\frac{1}{4}$″ between the lines of writing. The selection of either ruling should be made on the basis of other factors than the legibility of handwrit-

ing, since legibility is not modified by the use of either spacing.

4. Evenness of alinement need not receive special emphasis in the teaching of handwriting. Uneven alinement adds slightly to the legibility of handwriting, but is not of sufficient importance to be considered as an end in itself. If correct letter formation is emphasized sufficiently in the teaching of handwriting, the letters will be well alined. Uneven alinement is likely to be caused by poor letter formation. For that reason it is not desirable to teach children to write with uneven alinement. It is quite probable that, aside from a possible esthetic effect, no end is served by insisting that handwriting be perfectly alined. If good letter formation is set up as the chief outcome of handwriting instruction even alinement will probably be an accompanying result. Handwriting of good quality is produced by rhythmic movements of the hand and forearm, and even alinement is a natural outcome of rhythmic movements in the writing process.

5. The regularity of slant is important as a component of legibility of handwriting. It is important, therefore, if the writing is to be legible, that the slant of writing be more or less uniform. Uniformity of slant is closely related to good letter formation in the writing process. No attempt was made in this study to determine what slant is best for the sake of legibility, but the investigation does show that the regularity of slant is important. The teaching of handwriting, therefore, should emphasize regularity of slant as an important item. The slant of handwriting is conditioned by the muscular control and skill of the writer. Teachers should emphasize regular slant as an important aspect of correct letter formation in order to increase the legibility of handwriting.

6. The weight of line employed in handwriting is not an important matter, judged from the point of view of legibility. It is probably best that children should use a medium weight of line. Neither a heavy line nor a light line is clearly superior to a medium weight with respect to legibility. The manipulation of a medium weight of pen is probably more satisfactory, from the point of view of the pupil who is learning to write, than is the use of a fine pen or a coarse pen. Since there is no clear-cut case for either the light or the heavy pen, it is probably best to use a pen of medium weight.

7. Handwriting has social value only as it provides a more or less permanent record which can be read by someone. Children should be made aware of the necessity for producing a legibly written record, and should be made to understand the extent to which the different characteristics of handwriting enter into the composite characteristic designated as legibility. Slant, alinement, and the other characteristics should receive attention, not as important outcomes in themselves, but because they contribute to improved legibility of the handwriting.

"WHAT IS CLASSIFICATION"*

ARTHUR O. ENGLAND**
Captain, Air Corps
and
HARRY LAURENT, JR.***
2nd Lt., Air Corps
Hq., AAF Eastern Flying Training Command
Maxwell Field, Alabama

FOREWORD

There were many months when overseas requirements for personnel and increased training demands left the Army Air Forces stations in the continental United States short of qualified specialists in many occupational fields. At that time everything possible was done to assist the operating officers in getting the greatest amount of productive work out of the personnel available to them. This article was written to show them the part played by the Army Air Forces personnel classification and assignment system and how

classification could help them accomplish the required work of their department. The material presented here was also used in the Army Air Forces Classification School conducted by Headquarters, AAF Eastern Flying Training Command, Maxwell Field, Alabama, to give new students an over-all picture of the Army Air Forces classification and duty assignment program before taking up the policies and procedures in detail in the course of instruction.

At the present time there is a desire on the part of civilian agencies to learn Army procedures which, in many instances, could not be published because of security and policy

* This booklet was written and published in May 1945 for the AAF Classification School, conducted by Headquarters, AAF Eastern Flying Training Command, Maxwell Field, Alabama.

** Captain Arthur O. England is Director of the AAF Classification School.

*** Lt. Harry Laurent, Jr., is Chief Instructor of the AAF Classification School.

reasons until the surrender of Japan. As a part of the program of civilian enlightenment, certain staff officers in the Army Air Forces have been requested to prepare releases to the public to explain these procedures. The Army Air Forces Classification School has received many requests for this booklet from high officials in public administration, United States Employment Service, and from educators in Colleges and Universities. This article may serve as a guide to civilian employers in their relationship with veterans by describing the basis for the awarding of occupational classifications to military personnel, thus aiding them in making use of the training received by their employees while in the service. To educators, it will serve as an illustration of one type of training aid used in an Army Air Forces school.

A. O. E.,
H. L., Jr.

28 August, 1945.

An Army Without Classification

Prior to the entry of the United States into World War I, training in the Army was accomplished by the apprentice system, so no one was particularly concerned with identifying particular skills and abilities or with making assignments on the basis of these factors. Since the soldier was making a career of the Army, there was plenty of time to reassign him to other duties when it was determined that he was occupationally, physically, or mentally unfitted for the job to which he was originally assigned. Because of this, there was no system set up to properly classify and assign the large numbers of men being inducted into the Army in 1917. They were lined up and assigned to duties on the basis of their positions on an alphabetical roster of their organization or some other equally unscientific basis. Consequently, the training of some organizations was disrupted several times because it was determined later that certain specialists in these organizations were urgently needed elsewhere. When other units went overseas they left a large percentage of their men behind because it was discovered, too late, that they could not carry out the duties to which they had been assigned.

The Birth of a System

These circumstances emphasized the need for more careful classification and job placement, and steps were taken in this direction. A form was established to record the soldier's qualifications discovered through a classification interview, and tests to indicate learning ability were developed. The Army Alpha Test was given to all men who could read and write, and the Army Beta Test was administered to the illiterates. These improved techniques made possible more intelligent duty assignments.

With the Armistice in 1918 came a general reduction in military expenditures. Since it was felt that the personnel classification system had been adopted as an expedient to meet an emergency, it was one of the first things to be eliminated.

Even though the Army made but little advance in personnel management between 1918 and 1940, giant strides were made in both industry and education in the fields of testing, interviewing, and job analysis. So in 1940 there were available techniques and procedures that had been tried and proved. There was present, also, a realization of a great need. To meet this need a group of ex-

perts, representing business, industry, and education, was called into Washington to lay the foundation of our present military personnel classification system. A qualification card was adopted for both officers and enlisted personnel, a system of identifying occupational specialists was begun, and the Army General Classification Test and some visual classification tests were developed to replace the Army Alpha and Army Beta Tests. Much has since been added to this foundation.

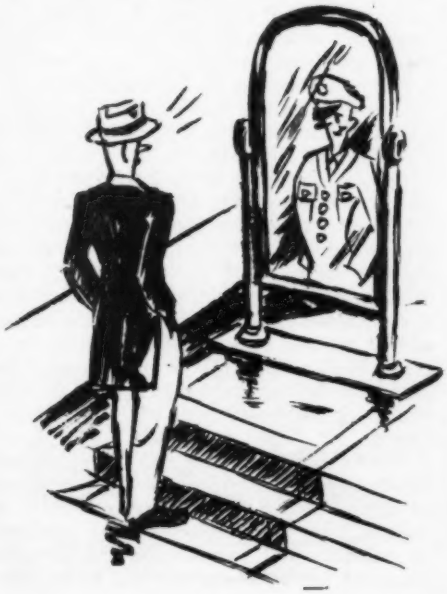
Throughout the present war the Classification Officers and their assistants, the enlisted Classification Specialists, have strived to improve their techniques and refine their procedures so that better results would be obtained from their work. This is an attempt to describe the Army personnel classification system in the hope that greater understanding will lead to greater success.

Steps of an Army Career

Practically all men coming into military life at the present time go through the same cycle. The first contact with the Army is at the Enlistment or Induction Station. The next stop is at the Reception Center. From there most men go to a Training Center for basic training. Upon completion of basic training, certain men are sent to Army schools and others are sent to organizations where their training is continued. They may be sent later to Army schools for special training. From the schools the soldiers go into Army organizations to do the work for which they are trained. The last step in this cycle is separation from the service.

Step one.—Men are selected by Local Selective Service Boards and sent to the Enlistment or Induction Stations, usually located in the larger cities. Here their fitness for Army duties is determined. Physical factors are studied by medical examiners and mental fitness is judged by the use of psychological examinations given by competent test administrators. Men may be rejected because of physical or mental unfitness.

The civilian becomes a soldier.—Reception Centers have the gigantic task of transforming civilians into soldiers. The new soldiers receive their uniforms, their records are initiated, immunization is begun, Army tests are administered, and they are interviewed by a trained classification interviewer. Probably the most important test administered at the Reception Center is the Army General Classification Test, or, as it is commonly called, the GCT. The score made on this test is an indication of the soldier's ability to learn Army duties. It is one factor to be taken into consideration in future assignments, but it is only one factor and its importance should not be over-emphasized. Furthermore, the GCT is



not an I.Q. test, in spite of the fact that it is often referred to as such by people both in and out of the Army.

The two other tests administered at the Reception Center are aptitude tests. One shows aptitude, or fitness, for mechanical work and the other for radio code work.

Since the use of test results has played a large part in the AAF classification program and since excellent results have been obtained in the selection of men for training on the basis of test scores, we will devote more time to testing a little later in this booklet.

How do we get our information?—One of the most important records initiated at the Reception Center is the Soldier's Qualification Card, the WD AGO Form 20. (These letters stand for War Department, Adjutant General's Office.) The chief way of obtaining information necessary for recording on this record is by a good personal interview. A good interview, one that is guided but not dominated by the interviewer, results in obtaining all the necessary facts about the soldier; informs him of his role in the Army; and motivates him to make the most of his assignment and to take advantage of all opportunities offered by the Army.

Interviewers are selected for their intelligence, interest in people, understanding of human nature, and knowledge of jobs. In order to obtain best results, the interviewer learns and practices certain basic principles of interviewing. In the very beginning he must set the interviewee at ease and state the purpose of the interview. Although he should not give the appearance of being rushed he should not waste time. Neither should he become a robot in his interviewing. He must learn to let the soldier do most of the talking. Leading questions, questions which put the answers in the interviewee's mouth, are to be avoided. The interviewer learns to use his tools, the most important of which are sources of information on occupations and oral trade tests to help him determine the soldier's familiarity with various jobs. The interviewer evaluates constantly all information given and makes an accurate record of the interview on the Qualification Card.

After the test scores and the information obtained during the interview are entered on the Form 20, the soldier is classified on the basis of his civilian occupation. He is also given a recommended military assignment.

However, no one gets a military classification until he demonstrates that he can do the work to the satisfaction of the Army. Both the civilian classification and the recommended assignment assist in the job placement of the soldier in his future organizations.

Army standards must be met.—The Army must make use of every man it possibly can. Many men who possess the necessary mental ability for induction into the armed services have not had enough formal education to permit them to learn a useful job in the Army, primarily because of a lack of opportunity. These are the illiterates, the non-English, and those men who score in the lowest seven percent on the Army General Classification Test. In an effort to salvage these men there have been established at Reception Centers special training units where instruction in simple reading, writing, and arithmetic is given. If it is determined in the STU that a man cannot absorb enough to learn Army duties he is returned to civilian life. When he meets the minimum literacy requirements, he is then ready for assignment out of the Reception Center.

Service Commands keep War Department Headquarters informed of the number of men in each of their Reception Centers. When the various arms and services request personnel by quantity and classification the War Department knows where they can be obtained

and places the requisitions on the Service Commands, who order the men out of the Reception Centers to the Training Centers of the arms or services initiating the requisitions. To insure the receiving headquarters of each arm and service of men with physical qualifications that can be used, the assignments out of the Reception Centers are made on the basis of the Physical Profile, which is described a little later.

Basic Training Centers

Basic rules are taught.—In the Army Ground Forces these installations are known as Replacement Training Centers, in the Army Service Forces they are called Training Centers, and in the Army Air Forces they are called Basic Training Centers. The primary functions of these Training Centers are the same but since this discussion is about AAF classification, we will describe some of the things that go on at a Basic Training Center. There are three AAF Basic Training Centers in operation at the present time, located at Keesler Field, Mississippi; Sheppard Field, Texas; and Amarillo Army Air Field, Texas.

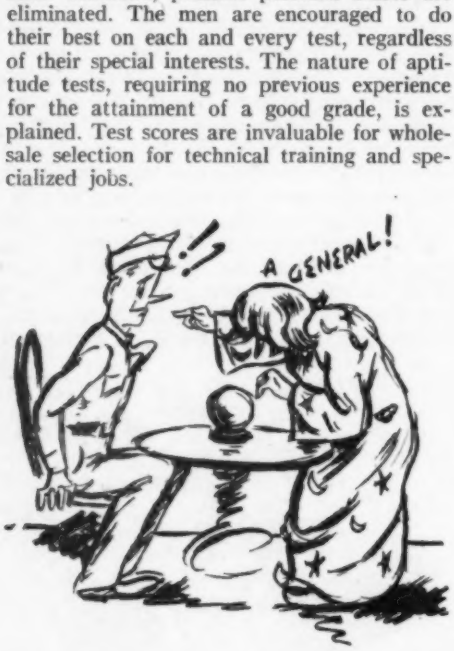
Men assigned to a Basic Training Center by a Reception Center are given a physical examination upon arrival to determine their fitness for combat crew training, that is, training to become a member of the aircrew on one of our bombers. During an orientation talk they are informed of the opportunities open to them. A definite effort is made to interest the men in aerial gunnery school since combat crew training is of high priority.

Why Test?—If the scores made at the Reception Center on the Army General Classification Test and the Mechanical Aptitude Test are high enough to indicate that a man could absorb and profit by technical school training he is given, at the BTC, a group of

aptitude tests to determine the type of training for which he is best fitted. The most certain way to establish the kind of training a man should take is to try him on several jobs or in several schools and by close observation decide the one in which his success is most probable. But in dealing with large numbers of men who must get a big job done in a limited amount of time this is not possible. Aptitude tests do not get results that are as accurate as on-the-job tryouts but their predictive value has been proved high and these results are obtained at small cost in time and money.

Predicting success.—We have to know more about a man than can be obtained from a personal interview. Tests give this informa-

tion. They constitute a short, objective method of observing a man in a variety of situations, while an interviewer can observe a man only once and in only one situation. Also, because tests judge every man by the same standard, possible personal biases are eliminated. The men are encouraged to do their best on each and every test, regardless of their special interests. The nature of aptitude tests, requiring no previous experience for the attainment of a good grade, is explained. Test scores are invaluable for wholesale selection for technical training and specialized jobs.

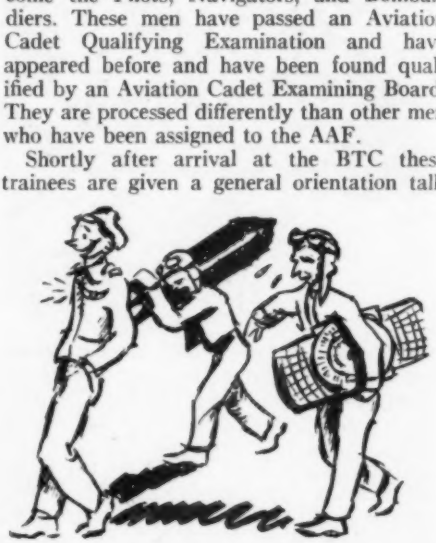


All men are interviewed at the BTC. During this interview a recommended assignment is made. All men physically qualified for combat crew are assigned to an aerial gunnery school or to a technical school which will be followed by aerial gunnery training. If a man is not physically qualified for combat crew but is qualified by his test scores for technical training, he is assigned to a school on the basis of his civilian background, existing quotas for the school, his aptitude test scores, and his personal desires. If it is felt that a man would be of more value to the AAF doing the same sort of work he did in civilian life, he is not sent to a school but is by-passed to an AAF squadron as a specialist. If he cannot qualify for a school or has had no valuable civilian job he is by-passed to a station where he will have an opportunity in his organization of assignment to learn a job by actually doing the work.

After completion of basic military training, which teaches each man the fundamentals of being a soldier, the men are ready for their assignments.

Selection of air crews.—One important group of men processed at the BTC's is the pre-aircrew trainees, the men who are to become the Pilots, Navigators, and Bombardiers. These men have passed an Aviation Cadet Qualifying Examination and have appeared before and have been found qualified by an Aviation Cadet Examining Board. They are processed differently than other men who have been assigned to the AAF.

Shortly after arrival at the BTC these trainees are given a general orientation talk



to acquaint them with the steps through which they are to go in the classification process. The first step in the procedure is the administration of psychological classification tests. These tests are given by a Medical and Psychological Examining Unit and include determination of psychological aptitude and officer qualification. Training preferences and previous flying experience are also determined at this time. The first day of testing is devoted to paper and pencil group tests while the following day a group of individual apparatus tests are administered to each man. The results of the psychological tests are expressed in terms of stanine scores. A trainee's stanine score has a lot to do with the type of training to which he will be assigned. The third day all men are given a rigid physical examination for flying. This examination includes a neuropsychiatric interview conducted by a Flight Surgeon, which assists in determining the trainee's mental stability and degree of emotional control which are important factors in flying.

There follows an interval of approximately ten days during which the results obtained by the Medical and Psychological Examining Unit are tabulated and analyzed. Scores on the psychological tests are confidential and are not disclosed, but each trainee is advised as to whether he is qualified or disqualified for aircrew training. If he is disqualified he is told whether the disqualification is based on the psychological tests or the physical examination. All disqualified men are given a brief let-down lecture to explain to them the reasons for their disqualification and to present some statistics showing the validity of these psychological tests.

Qualified Pre-Aircrew Trainees are given thirty-five days of basic training at the BTC and are then transferred to on-the-line training. This training is given at stations where other Aviation Cadets are receiving their flying training. The trainees work on the maintenance line where they become familiar with the different types of aircraft and learn something of their maintenance before being transferred to Pre-Flight School to begin their actual aircrew training. They are assigned either to Pilot, Bombardier, or Navigation training, depending on training quotas, stanine scores, and the preference of each individual.

Another group of men processed at a BTC is the combat returnees who are transferred there from stations of the Personnel Distribution Command. They hear orientation talks and are given several assignment possibilities, including a suitable technical school course, an instructor's job in a technical school, a permanent party job at an air base, or a refresher course in aerial gunnery and return overseas for those who volunteer for another tour of combat duty.

How to Make A Technician

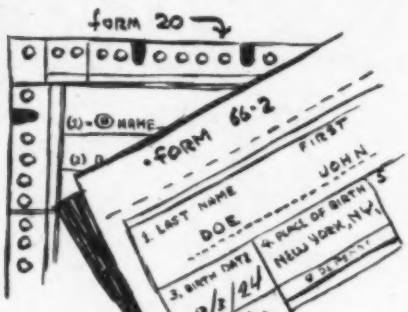
Men are assigned to the Army Air Forces technical schools from the BTC's and also from other AAF installations. The Classification and Assignment Officer at the school has three main problems in connection with the men who have been sent for training. The first of these problems is the screening of the men who have been sent to ascertain their fitness for the type of training they are to receive. They must be qualified in accordance with existing regulations and requirements. His second problem is the maintenance of the WD AGO Form 20 for each man at the school. To keep this card current he must enter on it such information about the school as its duration, the type of course, the academic rating earned, the type of equipment worked with, and the date completed. Finally the Classification and Assignment Officer assists in assigning the graduates to organizations where their training can be used. If the individual completes the course successfully he is awarded a semi-skilled rating in the particular job in which trained. This will earmark him wherever he goes as being qualified to do that type of work.

Basic Personnel Records

The time that a soldier spends in the Basic Training Center and the technical school is only preparation for the part that he is to play in the mission of the Army Air Forces —to bomb and destroy our enemies. He may not pilot the B-29 that drops incendiary bombs on a Japanese storage plant but the job that he does makes these raids possible. After he has been assigned to an Army Air Forces unit, his classification records are maintained as conscientiously as the payroll so that the man's top skills will always be

accurately reflected and available for use. These records are the Form 20 for enlisted men and the Form 66-2 for officers.

These records must be kept so the commanders will know at all times the exact qualifications of the men under them. No commanding officer can possibly remember all the relevant information about the various men he has working for him. The WD AGO Form 20, the Qualification Card, is initiated when a soldier enters the Army and contains all pertinent information concerning his background, education, age, previous service, physical status, aptitude test scores, and many other factors. This Qualification Card is kept current and reflects all important changes in the soldier's status. When he attends a service school, when he changes his job, in fact, any event that affects or indicates his usefulness is entered on the Form 20.



It is the basic reference in classification and assignment; basic source of information for personnel accounting. Forms 20 will tell how many and of what kind are available for use. Whenever a decision is made on the basis of a soldier's experience or aptitude, the Form 20 is consulted. Commanding officers or departments can refer to the Forms 20 at any time for information about their men.

Wherever the soldier goes, so goes his Form 20.

Just as the records must be kept current on enlisted men, so must they be maintained on officers. The Officer's Qualification Record WD AGO Form 66-2, a yellow paper form, reveals essentially the same information as does the WD AGO Form 20, except special consideration is given to civilian experience and record of current service. Practically everything that happens to the enlisted man's Qualification Card happens to the officer's except that manner of performance ratings are entered on the 66-2 at specified intervals throughout the year.

The Army Air Forces Medical officers have a special Qualification Record, called the WD AGO Form 66-3. It is fundamentally the same as the Form 66-2, except that special emphasis is placed upon the civilian medical experience of the officer.

What is an MOS?

The AAF is an army of specialists. In order to properly identify these specialists there has been established a standard system of labeling them. These labels are Military Occupational Specialties, or MOS's. A member of the AAF is aware of the importance of his MOS because it represents the job of the highest level of skill that he has demonstrated that he can do in the AAF. This standard system of job classification has other values. It expedites the requisitioning of personnel because needs can be expressed in terms of the number and type of specialists required to carry out the mission of the organization. This standardization facilitates record keeping and since it is a uniform system we can be sure that an Airplane Sheetmetal Worker, SSN 555, requisitioned from a station in Florida, will possess essentially the same qualifications as one requisitioned from a station in Arizona.

Just what is a Military Occupational Specialty, or MOS? It is a group of related duties and responsibilities which make up an Army job. In a manual prepared and published by the AAF these jobs are described in such a way that even though the reader is not familiar with job analysis he can determine what qualifications a soldier should possess in order to satisfy the requirements for the MOS. Each MOS is identified by a job title and a specification serial number, the SSN. For enlisted men these SSN's are always three and four digit numbers. An MOS is usually referred to by its SSN. For example, Cook—060.

When a soldier receives enough training or experience in a specialty to enable him to do a good job for the AAF, he is awarded this MOS. A man may have as many MOS's as he can qualify for, but one of them must be

designated as his primary MOS. If he is qualified in more than one MOS, his primary MOS will be that Army job which requires the highest level of skill, the longest period of training and experience, and is of the greatest value to the AAF. All other MOS's are additional MOS's. This system allows each man to acquire additional skills and to keep them as part of his permanent record so that they can be used when needed. A soldier in the AAF can earn an MOS in two ways. One of these is by successful completion of a technical school course and the other is by on-the-job training. Some men will require less on-the-job training than others to learn the duties of the specialty. This may be because they have had a similar job in civilian life or a related job in the Army; because civilian or military education has helped prepare them for the work; or because they have more general learning ability or specific aptitude for that type of work. The complexity of the specialty involved will also effect the time element in obtaining an MOS.

There are three degrees of skill that might be applied to an MOS. These are potential, semi-skilled, and skilled. The potential rating has limited use. It simply means that although the soldier has not had direct qualifying experience for the job there is something in his background such as experience or training in a related field or a high score on an aptitude test which indicates that he would be a good risk in the duties of that specialty. When a soldier has been rated semi-skilled in his MOS it means that he has demonstrated by performance on the job or successful completion of a technical school that he can, with the help and supervision of his department head or the non-commissioned officer in charge of his section, do most of the duties required in the job description. A skilled rating indicates that he has demonstrated by performance on the job that he can, with just the minimum amount of supervision that anyone can expect in the Army, do all the essential duties required in the job description.

It is the aim of the AAF that every soldier be trained for the highest specialty in which he can qualify as a skilled worker. Since there is no place in the AAF for a "career semi-skilled specialist," each man has a specified length of time during which he must become skilled or be reassigned to other duties. This time limit stimulates the learning process and guarantees that the soldier is in training for a job that he can learn without putting him under too great a strain.

The AAF uses many and complex types of equipment. For this reason a technician who is proficient in one type of equipment may not be able to use another type without additional training. To guard against sending men to a station where different types of equipment are used a notation is made on the Form 20 of the make of aircraft or kind of radio set on which the soldier has had experience. For example, if he is an Airplane and Engine Mechanic, his Form 20 might show that he has had experience in one or more types of aircraft. If he is an Airplane Armorer Gunner, his Form 20 will show with what type of aircraft he is proficient. This is a great help in the assignment of AAF technicians.

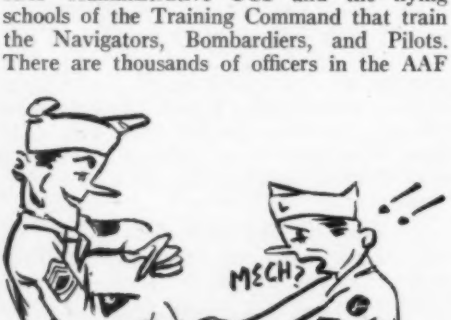
Plugging up the loopholes.—Simply because a soldier has acquired an MOS does not mean that he cannot advance. Jobs are arranged within job family groups in order of their levels of skill and training required and when a man has proved that he can qualify in a higher MOS it is awarded to him. This type of reclassification is always encouraged. Sometimes because of physical disabilities or other reasons a man is no longer qualified to hold an MOS in which classified and must be reclassified to a lower MOS. In order to protect the enlisted man's interests in this matter Classification Boards have been set up and approval of this Board must be obtained

before a man's MOS can be changed downward. One of these boards has been set up at each station. The Classification and Assignment Officer is a member of the Board and is its chief advisor. Another member of this Board is a representative from the enlisted man's squadron or department. The Base Personnel Officer is often a member. This board is set up to safeguard the correct classification and duty assignment of enlisted personnel. Before a soldier can be reclassified downward he must appear before this board and his entire case must be heard.

Visual checks.—To add distinction to certain AAF jobs that are so necessary to keep the planes flying, technical specialists sleeve patches have been authorized for wear on both the work and dress uniforms. These sleeve patches are equilateral triangles consisting of a distinguishing gold design on an ultramarine blue background. These designs distinguish between the five job groups for which sleeve patches are authorized: Armament, Communications, Engineering, Photography, and Weather. These sleeve patches help identify specialists both on and off the job.

Classification of Officers

Our two chief sources of officers are the AAF Administrative OCS and the flying schools of the Training Command that train the Navigators, Bombardiers, and Pilots. There are thousands of officers in the AAF



who are performing jobs of a highly technical and specialized nature. In order to identify these jobs and the men who are filling them, a system of job classification, paralleling the system for enlisted personnel, has been established. This is a standardized four-digit code system and before an officer can be awarded an MOS he must have demonstrated that he can perform the duties required by the job.

The officer classification system functions in the same way as the enlisted with a few exceptions. Officers are not rated as skilled or semi-skilled. They receive periodic efficiency ratings from their supervisors which give an indication of their ability in their jobs. Since an officer's MOS represents his profession in the army it requires action by his supervising officer to change his classification.

Job Placement in the AAF

As we have mentioned before, one of the chief reasons for the Army personnel classification system is its value in assignment. Under a Utopian setup each man would be assigned to duties consistent with his primary MOS. But when one considers the gigantic task assigned to the AAF and the millions of men selected to carry out this task one can easily see that this Utopia is impossible. Men should be assigned to duties commensurate with their abilities and in keeping with the current needs of the AAF. The Classification and Assignment Officer is the logical person to make these assignments. Each month he receives a list showing the specialists who are

considered critically surplus and short in the AAF. He keeps a current inventory of his station's needs. He knows the requirements for the awarding of MOS's and can get additional information from a personal interview. He can interpret test scores and knows just how much importance should be attached to them in comparison to education, past experience, physical qualifications, personality, and interest—all important factors to be considered in assignment. When the Classification Officer makes or recommends an assignment he is putting all these things together in an effort to make the best possible use of each individual soldier.

Interpreting test scores.—Although each man has received a number of tests before he arrived at an AAF organization, there is still some testing done there. For instance, a man may be required to pass a special examination for attendance at an Officer Candidate School, to be made a Warrant Officer, or for various other reasons. However, the Classification Officer's important job in connection with testing is more in interpreting test results than in the administration of additional tests. Each test is developed for a particular purpose and use; therefore, it is important to choose the right test for each classification or selection problem. A test that is good for one purpose may give useless or misleading information when used for a different one. The Classification Officer must be familiar with all Army tests and understand the meaning of their scores.

Reinterviewing is often needed.—Interviewing is done no matter where the soldier is stationed. It will be as formal or informal as the situation demands. The importance of good interviewing will not diminish. All classification personnel strive constantly to master the techniques and principles of interviewing. Officers and enlisted men are interviewed to check their records and to bring them up to date, for selection for technical schools, and for selection for special assignments.

As his job title implies, classification and assignment are two primary functions of the Classification and Assignment Officer. To successfully carry out these functions, he must be able to secure information to properly label men and officers, he must know what type of men are needed in his organization, and he must know what qualifications are needed to fill the jobs in the Army Air Forces.

A code system to show physical qualifications.—The importance of the part played by a man's physical condition in his assignment has always been realized but it has been only recently that a system of designating physical qualifications has been adopted universally by the Army. It was not enough to establish a code system to identify the various jobs in the Army, but also codes had to be devised to identify the soldier's general physical ability and personal fitness. The Physical Profile Serial was set up to reflect a functional, descriptive estimate of the fitness of a soldier, which, with his other qualifications, can be used to place him in the best Army job.

The Physical Profile is determined by six factors represented by six letters as follows: P,U,L,H,E,S, each letter corresponding to a functional part of the various organs, systems, and integral parts of the body. For example, the letter U represents the Upper Extremities: functional use of hands, arms, shoulder, girdle, and spine to include strength, range of motion, and general efficiency. Further, each of the six letters are given a numerical rating from 1 to 4: 1 represents full combat military service; 2, duty in close combat support and jobs less exacting physi-

cally; 3, duty at bases either in U. S. or overseas, and also represents minimum standard for acceptance to military service; and 4 represents defects that are below minimum physical standards for induction. Then the numerical numbers are arranged in the same consecutive order of the 6 letter word, PULHES, e. g., 211211.

By a survey of the 6 digit serial numbers recorded on the soldier's WD AGO Form 20, any headquarters can tell how many people they have qualified physically for assignments to special jobs. By use of the Profile Serial Number, soldiers may be transferred from one branch of the service to the other without one branch receiving men physically incapable of doing their job.

AAF Adjustment to Changing Fortunes of War

Because the fortunes of war are so unpredictable, training quotas have been overestimated or underestimated for some specialists. These changing needs for various specialists in the AAF, together with the curtailment of technical school training, have resulted in the creation of certain specialized types of overages and shortages in the AAF. To adjust more adequately these variations, to avoid retraining except when necessary, and to minimize waste of prior training, the AAF set up an on-the-job retraining program.

To the Classification and Assignment Officers has been delegated the responsibility of accomplishing this retraining.

The retraining program is generally guided by a list of critical surpluses and shortages for the AAF at large, published monthly. Proper retraining prevents future training in an already surplus job and at the same time encourages retraining in those jobs that are listed as a shortage.

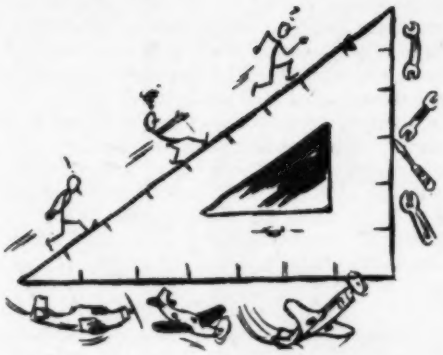
The principles of retraining are: Retrain the least trained, least skilled man in any specialized occupational field of skill. Fill vacancies in a field of skill that is short by these least trained people.

Personnel Control Procedures

Classification records are maintained in the classification office usually located at the base headquarters and it there that the Classification Officer prepares his reports to higher headquarters. However, when a change takes place in a soldier's duty assignment or in his qualifications it happens on the maintenance line, in a supply room, or wherever he might be employed. In order to get this change or request for change to the classification office, it is imperative that there be established a simple, well-defined system of personnel reporting on each base. This system must be controlled by the Classification Officer so that needed information will be reported and everyone concerned notified with as little waste of time and effort as possible. The time spent in completing reports of classification changes will pay off in increased efficiency in the use of station personnel.

Deciding How Much and of What

With the decrease in the number of men available for induction into the Army an increased emphasis must be put on the efficient



use of personnel. The mission of any station must be performed and performed effectively with fewer personnel. The aim of good manning is maximum utilization of manpower. However, such utilization can take place only if we are assured of an equitable distribution of available manpower. To begin at the very roots of this problem, each and every activity must be adequately staffed. However, to be over-staffed on one activity is to be so at the expense of other vital activities. The Manning Table is exactly what it is named—the amount of personnel necessary to man the station. It represents a guide since it sets forth the number of personnel, by job, required for each function at an air base. By the application of the "yardstick" to each of the functions at a station, the total manpower requirements by type job for that air base may be ascertained consistent with the various workload factors.

The requirements in a Manning Table are broken down to show officers, enlisted, and civilians. In this connection it is imperative that classification personnel be familiar with the problems of civilian personnel. Civilians are a definite part of the manning problem and their employment to the best advantage goes a long way toward effecting efficient personnel management.

Backbone of the AAF

Classification and Assignment Officers are no longer thought of as theorists, as longbeards whose chief tools are mysterious psychological examinations, or as idealists who insist that each man can do one and only one job regardless of the needs of his organization. He is now regarded as a practical man with practical ideas. He is familiar with the situation at his station and is aware of the problems. One of the big problems is supplying the personnel to keep the planes in the air so he must learn the difficulties involved in aircraft maintenance and repair.

Aircraft maintenance and operation are specifically peculiar to the AAF. The Airplane and Engine Mechanic is the mainstay of the Air Corps. Particular attention must be given to engineering activities. Because of the expense involved in sending the aircraft maintenance people through the long and complicated technical schools, we cannot afford to permit their assignment and utilization to be slipshod.

Very often personnel officers fail to realize the complexity of aircraft maintenance operation. For instance, the typical operation is divided into four phases, depending upon the degree of complexity of the maintenance work to be done. Levels of maintenance are broken down as follows:

First level (echelon), minor repairs and replacement; servicing of airplanes and equipment.

Second level (echelon), engine changes; tools and equipment for repairing to be transported by air.

Third level (echelon), fabrication of minor repairs, engine build up; use of mobile machinery.

Fourth level (echelon), restoration of completely worn out or damaged aircraft; major overhauling.

It is obvious from this analysis of maintenance that care must be exercised in assigning maintenance personnel to jobs that are commensurate with the level of their training. The more experienced personnel should handle 3rd and 4th echelon maintenance and repair. Needless retraining can be prevented by knowledge of aircraft maintenance operation and proper assignment therein.

Classification Up and Down the Line

To be effective, the classification program must be coordinated at each command. Personnel at each level must know their function and understand their contribution to the entire effort.

At command headquarters the classification sections are essentially "policy formers". They are the guiders, the writers of directives, the promulgators of theories, the promoters of standard practices, the adjusters of surpluses and shortages, and the inspectors of the sub-commands and air bases.

At the stations on air bases, the classification sections are the people who actually do the job. They do the interviewing, the testing, the assigning. They train and retrain. They maintain the records, make the reports, select the men for shipments.

The eyes and ears of classification.—The classification man is the final checkerupper at the squadron level. He watches the men on the jobs, he lives and talks with them. He is the main "buffer" between the post headquarters and the working man himself. He is the initial reporter of changes in personnel status. He is the maintainer of good personal harmony in the squadron.

Regardless of how efficient and capable the Classification Officer may be, his success will depend, to a large extent, on the caliber of his assistants, the enlisted Classification Specialists. These men are the experts in the field of classification. They work in the base classification office, in the squadron, and on the maintenance line. They prepare reports and maintain records; they assist department heads and squadron commanders in reporting personnel changes; they keep station personnel informed of changes in their MOS's and of training opportunities open to them; they know their classification regulations and directives cold. These men are carefully selected, trained, and indoctrinated. Their aim is to assist the Classification Officer by assisting operating officers in the best use of the men assigned to their departments.

Seeing is Believing

One of the important functions of the Classification Specialist as well as of the Classification Officer is spot checking. Since the Classification Officer must certify that all men are correctly classified when they are transferred overseas it is essential that he have the opportunity to verify the information that has been reported to him and that appears on his basic records. He can do this only by going to the spot where the men are actually working, and observing them at their duties, talking with them about their jobs, and discussing their progress with the department head.

Ordinarily, spot checkers will be sent to the various departments with specific instructions. Whenever possible an attempt is made to minimize interference with the duties of those involved. Care is exercised in selecting the time for the check since the impediment of necessary operations must be carefully avoided.

To make a successful spot check the checker must be courteous and make it evident that the function of the check is not of a disciplinary nature. The individual making the check is simply endeavoring to gather certain facts which, when presented in the form of a report to proper authority, will constitute the basis for assisting those involved to comply with regulations and to utilize manpower more efficiently.

The spot check is an instrument of education for both the checker and the person being checked. Thoroughness, involving a complete understanding of the job done, tools used, and the relationship of the person being checked to the mission of the unit, will be of tremendous assistance to the checker in other phases of classification and personnel work. At the same time, the spot check provides an

opportunity for the indoctrination of department heads and workers with an understanding of what is being done, and what classification and assignment personnel are attempting to do. As such it is an instrument for the stimulation of higher morale, and is concerned both directly and indirectly with productive efficiency.

Personnel Management in the AAF

The Classification Officer is not only an important cog in the administrative machine at the station but he is also a personnel manager. He practices the principles of personnel management in his own section and assists in the entire program in his organization. Personnel management is simply getting the most out of what you have. It is the elimination of wastage of manhours, abilities, and materials; it is the accentuation of the maximum in efficient utilization of all available manhours. Personnel managers must keep informed about their agencies, devices, techniques, and methods on the particular air base which will tend to promote greater production.

There are three equally important phases of good management. Written as an equation they are:

Plan + Operate + Control = Personnel Management.

There are certain key operational points to be considered in achieving efficient management. Listed in order of priority they are:

Get the right man.
Keep him in a required job.
Increase his availability for work.
Use him fully.
Use him on essential tasks.
Stimulate his will to work.
Improve his capacity to produce.

In order to get a management program to work, it is necessary that the key staff officers

at any Army installation operate as a team, each directing his effort toward the common goal—efficient utilization of available manpower.

Salesmanship pays off.—On the basis of the record of the classification and assignment program it is difficult to understand why classification personnel, occupied with urgent duties, must devote so much time to selling their program. For example, uninformed people are prone to judge the entire program on isolated cases of poor classification or assignment and, at the same time, ignore all the good work that has been done. Others blame classification because it is necessary to use men who have been trained for a specialized job in other duties. This is the result of overestimating training requirements, estimates that were based on anticipated needs which vary with the fortunes of war. Classification has made mistakes and classification personnel are the first to admit them and to strive to profit by them.

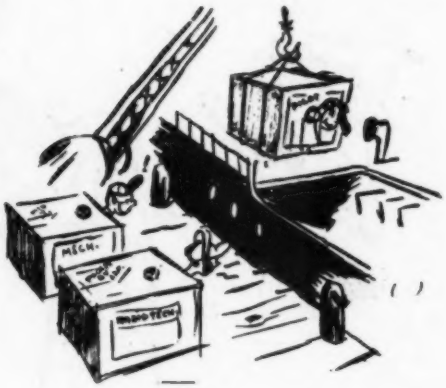
The principles of classification indoctrination are simple. Support for the program is solicited from key station personnel. Those who have anything to do with the classification program either directly or indirectly are shown the values of and the most effective methods of using classification tools. All station personnel are encouraged to use the data on personnel that is available in the classification office to increase the efficiency of their own departments through more effective use of personnel. By doing this they will become aware of an organized program of fitting the right man in the right job, benefits that will also be felt by each individual involved and by the AAF.

A Clearing House

So far we have seen how classification and assignment activities affect the lives of enlisted men and officers upon their entry into the Army, in the AAF Basic Training Centers, in technical schools, in AAF organizations, and in their selection for overseas. There remain two important steps for the large majority of men in the AAF. One of these is the processing that they go through enroute to an overseas assignment and on their way back to a station in the United States. The other step is the one in which everyone is most interested—Separation.

The AAF set up a general clearing house for its personnel—The Personnel Distribution Command. The final okay is put on those men at the Overseas Replacement Depots before they leave the U. S. for overseas. By means of ORD's the AAF is assured of sending only qualified personnel overseas, men who have been processed completely to meet all emergencies there. The unqualified are culled.

The other big function of PDC is the handling of personnel returned from overseas. If the returnee needs medical attention he goes to a General Hospital or Convalescent Center depending upon the severity of his condition. After sufficient medical treatment has been given and the returnee is sufficiently rested, he is ready to be processed for further use in the continental Air Forces or Commands.



The Redistribution Stations process and orientate the returnee so that he can be utilized again. Enough work is done on his records, clothing, and equipment so that he can be made available to some continental Air Force or Command for the assignment that is recommended by the interviewer at the Redistribution Station. Rest and orientation put him in the proper physical and psychological condition to go back to productive work for the Army.

This Way Out

Before D-Day in Europe there had been well over one million men separated from the service. The rate of separation will increase until the end of the war when the millions of men now in uniform will have to be mustered out. Separation Centers have already been set up all over the country and are organized to do the job with speed and efficiency.

The job of classification at a Separation Center reverses the procedures of the Reception Center. Soldiers being discharged hear orientation talks on the situation in which they will find themselves; the desirability of making definite occupational and educational plans; and the classification and counseling facilities that are available to them in the Separation Center. All the soldier's personnel records which are available and pertinent to classification are reviewed and checked. He is interviewed and his service and pre-service occupation and educational history and training are determined and summarized on a brief factual record. He is given information on civilian occupations requiring similar skills and is informed of established civilian agencies that will help him in his occupational plans. He is given an opportunity to take selected aptitude and trade tests to facilitate his planning. Although the soldier does not have to use the counseling services available at the Separation Center many of them do. This is their chance to ask questions about occupations, education, and personal adjustment problems—the answers to which are of maximum importance to the new civilian.

Journal of Experimental Education

Purpose

The Journal of Experimental Education is a technical journal published for technical workers interested in the experimental study of education.

A Project in Cooperative Printing

The Journal of Experimental Education is a project in cooperative printing, charging a contributor's fee of $2.50 per page of approximately 750 words calculated on the basis of the cost of publication. The rates here established are based upon a number of years of experience, and are set to cover operating expenses.

The Journal is Published Quarterly

The Journal of Experimental Education is published quarterly, in September, December, March, and June, each issue being devoted to a special phase of education: The September issues to experimental studies of learning, teaching, and supervision; the December issues to child welfare, guidance and development; the March issues to measurements, statistics, and the methods of experimental research; and the June issues to curriculum construction.

Reprints

Besides the author, any reader may order reprints in lots of 100 or more within thirty days of publication. The Journal can also furnish at any later date, by the photo offset method, reprints of any single article or selected group of articles in lots of one hundred copies or more desired for class use. If the author prefers, preprints can be secured at the time of the acceptance of the paper prior to the date of publication.

Research Monographs

The Journal of Experimental Education is prepared to publish not only reports of research as articles and reprints, but also as Research Monographs. Many persons and institutions lack the means and facilities for making the results of worthwhile research available to others. The Journal of Experimental Education can do this on a reasonable basis.

Preparation of Manuscript

Many articles reach our editorial office before they have been put into final form for publication. Manuscripts should be typed, double spaced with wide margins on 8½ by 11 inch paper. Submit only first copy. References and footnotes should be complete (author, title of the work, facts of publication, volume, date, and pages), unabbreviated, and numbered consecutively throughout the article. Tables should be numbered, titled, ruled, and each column labeled so the materials are clearly understandable. Drawings should be made on a good quality of white paper with black India ink. Letters, numbers, etc., at the margin should be in proportion to the rest of the drawing to be legible when reduced. Prepare the original copy exactly as you want it to appear in print. This will save money. Consult recent issues of the Journal for matters of form, style, etc.

Subscriptions

The subscription price is $5.00 per year, in advance; domestic and foreign. The price for a single copy will vary from issue to issue, depending upon the size of the issue. The price for single copies is given on the front cover of each issue. Lots of 25 copies or more of single issues may be purchased at a 20% discount.

Editorial Matters

Address all communications on editorial matters to A. S. Barr, Editor, Box 2, Education Building, University of Wisconsin, Madison 6, Wisconsin. Manuscripts intended for publication in any one of the above named issues of the Journal should reach the editor at least sixty days prior to the date of publication. Postage for the return of the manuscript should be enclosed.

Business Matters

Address all communications on business matters, subscriptions, reprints, contributor's fees, advertising matter, etc., to Dembar Publications, Incorporated, 114 South Carroll Street, Madison 3, Wisconsin.

Research Monographs and Reprints

A. S. Barr, R. E. Gotham, A. G. Hellfritzsch, C. D. Jayne, C. V. La Duke, J. F. Rolfe, L. E. Rostker, and C. E. Von Eschen, *"The Measurement of Teaching Ability,"* Reprinted from the *Journal of Experimental Education,* XIV (September and December, 1945), 206 pp. $3.00

This report supplies new materials on the progress that has been made in the measurement of teaching ability during a ten year period, 1935–1945, and contains valuable data on the validity and reliability of a large number of new tests, rating scales, and other measures of teaching ability.

Leslie L. Chisholm, *The Shifting of Federal Taxes and Its Implications for the Public School,* Research Monograph (Madison, Wisconsin: Journal of Experimental Education, 1939), 84 pp. $2.00

This monograph discusses the amount of federal tax revenue drawn from each state, from different sources, among which are corporation income taxes, personal income taxes, gift tax, tobacco tax, admissions and club dues, oleomargarine, adulterated butter, and narcotics taxes, etc.; the shifting of federal taxes and the public schools; and federal expenditures and the public schools.

Alice Sowers, *"Parent–Child Relationships From the Child's Point of View,* Reprinted from the *Journal of Experimental Education,* VI (December, 1937), 26 pp. 50¢

A study based upon 2000 essays from children and young people regarding home situations and practices which they think contribute to or interfere with satisfactory family relationships.

Walter R. Hepner, "Factors Underlying Unpredicted Scholastic Achievement of College Freshmen," Reprinted from the *Journal of Experimental Education,* VII (March, 1939), 39 pp. 50¢

In recent years much attention has been directed to methods of predicting the quality of a student's college work in advance of college entrance. This report supplies data in answer to the question: What are some of the factors underlying the unpredicted academic achievement of college freshmen?

Orlando E. Overn, "Changes in Curriculum in Elementary Algebra Since 1900 as Reflected in the Requirements and Examinations of the College Entrance Examination Board," Reprinted from the *Journal of Experimental Education,* V (June, 1937), 95 pp. $1.00

This study discusses various committee reports: the first definition of requirements issued in 1900; the second issued in 1903; the National Committee Report of 1923; developments in Algebra since 1923; questions on algebraic technique; numerical equations and problems; formulas, graphs, and trigonometry; and summary of data on examinations.

A. S. Barr and Nels O. Reppen, "The Attitude of Teachers Toward Supervision," *Journal of Experimental Education,* III (June, 1935), 64 pp. $1.00

A study of the attitudes of a large group of teachers toward typical supervisory practices and officials. Contains a large amount of concrete materials that should be of assistance to supervisors and teachers alike.

DEMBAR PUBLICATIONS, INC.

114 South Carroll Street

Madison 3, Wisconsin